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Forest Fires
and
Forest Fire Control
in
Michigan

J. A. Mitchell
Lake States Forest Experiment Station

and

D. Robson
Michigan Department of Conservation

MICHIGAN DEPARTMENT OF CONSERVATION
In Cooperation With
UNITED STATES DEPARTMENT OF AGRICULTURE
Forest Service

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LIST OF TEXT FIGURES

Figure	Title	Page
1-A	Number of fires, by years, Michigan—1910-1949	16
1-B	Area burned, by years, Michigan—1910-1949	17
2-A	Size of average fire reported, Michigan—1910-1949	18
2-B	Per cent of fires over 10 acres in size, Michigan—1916-1949	19
3	Early fire warning poster	32
4-A	Old open platform windmill type lookout tower	35
4-B	Modern enclosed tower with stairway	37
5	A Michigan forest fire speeder patrolman—1916	41
6	A "flying squadron"—1916	41
7	Standard fire truck for transportation of men and equipment, Michigan—1949	42
8	Standard trailer with fire-fighting equipment, Michigan	43
9	Michigan heavy duty tractor plow	44
10	Michigan standard double moldboard sulky plow	45
11	Bulldozer clearing a fire line through slash or heavy second growth	45
12	Michigan well-sinking outfit in operation	46
13	A Michigan trailer-mounted heavy duty power pump operating from a washed-in well	47
14	Michigan trailer-mounted booster unit	49
15	Area in need of protection from forest fires	52
16	Organization of the Michigan Department of Conservation	55
17	State and federal protection units, Michigan—1949	56
18	Prevailing cover types, Michigan	58
19	Relative risk of burning by cover types	60
20	Relative importance of causes, by years, Michigan—1914-1949	61
21	Risk of forest fire occurrence, by counties—1936-1949	64
22	Average seasonal distribution of fires and area burned, Michigan—1920-1949	66
23	Number of fires per year, by 10-day period, Michigan—1936-1949	67
24	Number of fires, area burned, and cost of protection, Michigan—1910-1949	70

INTRODUCTION

“**S**I QUAERIS PENINSULAM AMOENAM CIRCUMSPICE.” (If you seek a pleasant peninsula look about you.) So reads the motto on the great seal of the State of Michigan, and so thought the pioneers who came to the Northwest Territory in the early days of the nineteenth century to settle what was to become the twenty-sixth state of the Union.

Following the opening of the Erie Canal in 1825, settlers poured into the state in ever increasing numbers. With them came the lumberman and forest fires. By the close of the century the great forest of virgin pine and hardwoods, that once stretched practically unbroken from the Ohio-Indiana line to Lake Superior, was largely gone and the state had become the classic example of forest devastation. While logging was partly responsible for this deplorable condition, uncontrolled forest fires were chiefly to blame.

Since the advent of forest fire control, the picture has changed. Today a forest cover again clothes much of Michigan's cut-over land and the state once more lives up to its motto. What this means to the economy and prosperity of the state is indicated by the increasing number of vacationists and sportsmen who visit the state annually. But that is not all. The once barren waste left by the lumbermen is again becoming productive and holds out the promise of a perpetual supply of forest products sufficient, with proper management, to supply the industrial and agricultural needs of the state.

What has been accomplished in the way of forest fire control is shown strikingly by available forest fire statistics. Prior to organized protection the number of forest fires averaged well over 3,000 a year, the average annual burn over a half million acres, and the resulting damage to more than one and a half million dollars a year, without taking into account the enormous economic loss resulting from millions of acres of unproductive and tax delinquent land. Since 1930 the number of fires has been reduced by half, the area burned annually to less than two-tenths of one per cent of the area protected, and the direct losses, in spite of increasing values, to less than \$150,000 annually.

The record is one of which to be proud, but it does not mean that the fire problem has been licked or that further effort is unnecessary. The threat remains and only by eternal vigilance can forest fires be kept under control. It is true that the public in general has become more fire conscious, that we no longer have the vast unbroken areas of logging slash which once prevailed, and that the danger of fire has decreased as forest cover has become reestablished. On the other hand, the automobile, the airplane, good roads, a growing population, and recreational and industrial development have greatly increased the probability of fires. Young growth also is highly inflammable, especially conifers which, today, cover thousands of acres. Nor can the possibility of disastrous fires be ignored, since periodically conditions develop when even green timber will burn and the forest becomes a tinder box. Under such conditions every fire is a menace, and only by prevention measures and by prompt and effective control can disastrous conflagrations be avoided.

The protection of 20 million acres of forest land from fire is a big job and one that cannot be satisfactorily handled piecemeal or by half way measures. To ignore fires on denuded lands, for example, not only risks their getting out of hand and involving property of value, but effectively prevents such lands from becoming productive. An inadequate organization may be effective under normal conditions, but it breaks down when the situation becomes acute, resulting in the loss of past gains and efforts. Control cannot be limited to critical periods, for emergency conditions are unpredictable. Only by being constantly prepared to function can the situation be kept in hand.

While the cost of protection cannot always be justified by the tangible values directly involved, the fact remains that we cannot have both uncontrolled fires and productive forests, and unproductive forest land is a public liability. The threat of fires to life and property and to the economic stability of communities dependent on forest resources is another reason for forest fire control that cannot be ignored, although it is difficult to evaluate in dollars and cents.

Twenty-five years ago there was some question as to whether or not forest fire control could be made effective. Since then experience has demonstrated beyond a doubt that it can, and at a reasonable cost. The problem today is to keep it effective. If forest fire control was justified 25 years ago, it is doubly so today in view of the greater values involved, the increasing need for forest products, and the economic and social benefits dependent on forest cover and the productive use of idle land.

The purpose of the present publication is to review the development of forest fire control in the state, and to outline the problem as it stands today for the information of the public and as a guide for future efforts.

MICHIGAN'S FOREST FIRE RECORD

In few states have forest fires been more numerous or more destructive than in Michigan. From prehistoric times, but more especially since the beginning of active settlement, forest fires have occurred annually. The result has been the destruction of billions² of feet of standing timber, incalculable damage to other property, the loss of many lives, and more than 10 million acres of land kept unproductive for over two generations.

Evidence of prehistoric fires has been found in the charred remains of ancient trees in the sub-carboniferous sandstone on the western side of the Thumb and in the coal measures, glacial deposits, and peat bogs of lower Michigan. Fire scars on old trees indicate that forest fires have occurred periodically since present forests were established.

²W. N. Sparhawk, in *THE ECONOMIC ASPECTS OF FOREST DESTRUCTION IN NORTHERN MICHIGAN*, U.S. Department of Agriculture Technical Bulletin No. 92, states that, "Of Michigan's original stand of 380 billion board feet of saw timber, approximately 35 billion feet was cut and burned in clearing land; 73 billion feet was burned and wasted during or after lumbering or destroyed by forest fires independent of lumbering operations; 204 billion feet was cut for lumber; and 40 billion feet was cut for other products, such as railroad ties, shingles, staves, ship timbers, poles, pulpwood, veneer logs, furniture and vehicle dimension stock, and the like. In many parts of the State the amount of timber destroyed by fire exceeded the amount cut. In the region tributary to the Au Sable River, for instance, it has been estimated that 20 billion feet of pine was burned, and only 14 billion feet was cut by loggers."

The records of early explorers tell of fires set by lightning and by Indians to drive game or to harass their enemies, and frequent references to forest fires are to be found in old newspapers, historical documents, and the letters of pioneer settlers. As early as 1862 a slash fire destroyed the town of Alpena and burned sawmills at Lockwood and Minor. Again in 1863, 1867, and 1869, Alpena was partly or wholly consumed.

The Great Fires of 1871

Michigan's first recorded catastrophic fire occurred in the fall of 1871, at the time of the great Chicago fire and the Peshtigo fire in Wisconsin which took over 1,500 lives. Overshadowed by these more spectacular disasters, the Michigan fire received little publicity outside of the state and is less well known although it covered more ground than the Peshtigo fire, and according to the best estimates available, cost over 200 lives. Like most great forest conflagrations, it was not a single fire but a combination of hundreds of fires, small and large, that had been burning unattended for weeks, only to flare up and to unite when conditions became acute.

The summer of 1871 was one of the driest on record. From early August no rain fell, pastures and gardens dried up, wells went dry, streams shrank to a mere trickle, and crops failed. Set carelessly or by settlers in clearing land, fires burned everywhere, and ran uncontrolled into the woods and swamps where they continued to smoulder. September was equally dry. On October 5, forest fires were reported raging in northeastern Wisconsin. On the 6, according to the "Detroit Free Press:"

The lurid sun and warm winds which have prevailed here for several days past continues (and) fires in the woods keep up the smoky atmosphere which renders everything obscure. . . .

On October 7 it was reported that "the great woods and prairie fires in Wisconsin still continue and almost incalculable damage has already been done with no immediate prospect of extinguishing the flames," and that "navigation at Detroit has been suspended owing to the dense smoke and fog unparalleled within the memory of the oldest navigators."

Word of the Chicago fire reached Detroit at 12:30 a.m. Sunday, October 8, the day that Peshtigo was destroyed. On the eighth also, the following news item appeared:

Owing to the uncommon drought, dryness of timber and fallen leaves, numerous fires are raging in the southern portion of the State.

On the tenth, details of disastrous Michigan fires began to arrive. Holland, it seems, had been "reduced to ashes;" Manistee "nearly consumed;" Glen Haven "destroyed;" and fires had swept across the state to Lake Huron. The Saginaw Valley and territory northwest was reported fire swept, and fires were said to be raging in Genesee County and the Thumb. On the twelfth, word was received that Huron City, Sand Beach, White Rock, and Forestville had been completely destroyed, that a number of persons had been burned to death, and that "two-thirds of the population of Huron and Sanilac counties were

homeless." On the fourteenth, fires were reported to be increasing in Newaygo, Isabella, Gratiot, and Tuscola counties, and getting worse along Lake Huron. Sixty people were said to have been rescued from the lake where they had fled to escape the flames. On the eighteenth, "a large section of the State" was reported to have been "utterly desolated" and the U. S. Revenue Cutter Fesenden cruised along the shore to aid and transport victims of the fire to safety.

The following contemporary account of conditions appears in E. J. Goodspeed's "History of the Great Fires in Chicago and the West:"

Extreme drought had prevailed throughout the west for many weeks and there had not been a rainy day since the beginning of June. During this time fires were raging in the woods in many localities. The same gale which blew upon Chicago Sunday night, October 8th, swept over the burning woods of Michigan and Wisconsin, and in places increased to tornadoes, fanning the scattered fires into a general conflagration.

The disaster was most complete between Saginaw Bay and Lake Huron. Here "an area 40 miles square was completely devastated, and over 50 people were found burned to death." While the worst was over by the eighteenth, the fire was not completely out for nearly a month. As late as October 24, smoke was reported "troublesome" and "lake navigation difficult;" while on November 13, "contributions of money and clothing" for homeless refugees were "still being received." No accurate record of the area burned or the loss sustained was ever made, but it has been estimated that more than two million acres burned over, that several hundred families were rendered homeless, and that at least 200 lives were lost. The only reason that the loss of life and improvements was not greater is that the country at the time was sparsely settled.

The Thumb Fire of 1881

From 1871 to 1881 there is no record of any general conflagration, although the tenth Census records 238,270 acres as having burned in 1880, with a loss of \$985,980. In 1881, however, just 10 years lacking one month of the date of the great fire of 1871, that catastrophe was repeated. While not as extensive as the 1871 fire, the fire of September 1881, commonly known as the Thumb fire, was even more severe and did more damage since settlers had been pouring into the region and logging had gotten under way. As a result, many more people were rendered homeless and the loss was greater. It is estimated that this fire burned well over one million acres, cost 282 lives, and did more than two and a quarter million dollars worth of damage.

Like the 1871 fire, the fire of 1881 came at the end of an extremely severe drought and was the result of hundreds of land-clearing fires whipped into a seething cauldron of flame by high winds. It was worse in the Saginaw Valley and the Thumb region where it burned over much the same territory that had burned over ten years before. Its severity is accounted for not only by the drought and high winds that prevailed, but by the fact that the country was full of slash from logging and land clearing, and of dead and down timber killed, but unconsumed, by the fire of 1871.

No one who has not experienced a big forest fire can conceive of the appalling conditions which occur and the terror and helplessness of those in its path. The following excerpts from contemporary accounts give some idea of the conditions that prevailed:

From the "Evening News," Detroit:

Thursday, September 1, 1881: "The drought all over the Mississippi Valley and throughout the northwest continues with unabated rigor. Sun spots noted . . . Atmosphere scorches and blisters everything . . . vegetation dried to a cinder, gives nothing but material for fire. Trees shedding their leaves a month before the usual time; grass brown and withered. Pastures and streams dried up. Milk scarce, butter a luxury. If it does not rain and rain hard soon, food will be scarce this winter . . . Buyers paying the unheard price of 18 and 20 cents a pound for butter."

Saturday, September 3: "Farmer near Stark overcome while fighting fire and burned to death."

Tuesday, September 6: "Woman burned to death while fleeing for shelter near Lapeer . . . Kawkawlin in danger . . . terrible fires reported raging in the forests northwest and north of Bay City . . . air full of cinders . . . people suffering from heat and smoke . . . Fires devastating the woods around Flint."

"Saginaw: Intensely warm and smoke suffocating. East of city forest fires raging fiercely. Travel on Waterville plank road cut off . . . hundreds of acres afire. Fires plainly visible from the city at night . . . Indian settlement surrounded . . . Heavy fires reported in Blumefield and Bridgeport townships."

"Detroit: Heat and drought almost unprecedented. Throughout the timber regions great forest fires are raging in all directions from the Mississippi to the ocean. In many places the earth is so dry that fires have penetrated into the soil, following the vegetable fibers and moving mysteriously by this means over many miles only to break to the surface in a destroying conflagration wherever the surface vegetation furnishes fuel. (Fires) seem to break out spontaneously from the bosom of the earth."

"Port Huron: No telegraphic communication north of Cromwell. Port Hope reported burned and Port Austin and Island Beach believed to be burning. Tremendous fires in Sanilac and Huron counties . . . Richmondville destroyed and Deckerville reported burned . . . Eight lives known to have been lost. Many people horribly burned."

Wednesday, September 7, 3:00 p.m.: Wholesale devastation in Saginaw Valley and Huron peninsula. Entire townships become roaring furnaces and left in ashes . . . Over 30 lives lost . . . survivors fleeing to the lake. Tyne, Deckerville, Bad Axe, Verona Mills, Elk Creek, Richmondville, and Cato burned. Forestville on fire. Railroad and telegraphic communications cut off."

4:00 p.m.: "At least 100 lives lost in Sanilac County alone. Men, women and children burned on the roadside while seeking shelter. A norther sets in, fans flames and increases havoc. Medical aid and other succor needed. Six counties (Tuscola, Huron, Sanilac, Genesee, Montcalm, and Saginaw) have suffered. Villages of Port Hope, Bad

Axe, Verona Mills, Charleston, Minden, Forestville, Richmond, Anderson, Deckerville, Tyre, and Ubley in ashes. Fifty to sixty dead . . . more being found in cellars, wells, and root houses."

Thursday, September 8: "Several hundred lives known to be lost . . . thousands left homeless . . . principal destruction in Huron, Sanilac, and Tuscola counties . . . fires started from burning by settlers . . . forest fires reported in the vicinity of Holland and in Isabella County . . . west wind of Monday and Tuesday changed to north Wednesday."

Friday, September 9: "The worst ever: Thirty-one townships and eleven villages swept by the flames . . . 45 bodies found near Paris in Sanilac County . . . fire started in N.W. part of Sanilac County and in adjoining Huron County from settlers burning to clear land . . . spread east and north to the lake shore, then west through Grant in Huron County, then south and southwest, then east across Cass River where it met another part of the fire and raged for twelve hours . . . 500 to 600 dead (an overestimate) 2,000 families homeless, 15,000 destitute."

A later estimate placed the number of dead at 282, of which 167 were identified. The appalling thing about this loss of life was the large number of children involved due to whole families being wiped out. A current estimate placed the property loss at two and a half million dollars, \$75,000 to standing timber, fences, and fruit trees in Sanilac County alone.

Governor David H. Jerome twice sent out calls for relief and over three-quarter million dollars was raised. An interesting sidelight is that this was the first national calamity in which the newly organized American Red Cross participated as a relief agency.

A more intimate account of conditions is to be found in the story told by the Reverend Z. Grenell, Jr., of the First Baptist Church of Sand Beach (now Harbor Beach). A part of his statement follows:

At sunrise, Monday, September 5, the air was clear at Sand Beach. By 1:00 p.m. the sky was copper colored. At 2:00 p.m. it was so dark that lanterns were necessary out of doors to find one's way around. Darkness continued all afternoon. Many thought the end of the world was at hand. Terror heightened by the approach of flames, the stories of destruction to the west, and the arrival of charred remains and refugees. This continued until Wednesday morning, when at 8:00 a.m. the wind changed to north and brought relief along the shore.

A detailed account of the fires that burned in the Thumb is given in a report made by Sergeant William O. Bailey of the Signal Corps (now the Weather Bureau) who traveled over the burned area after the fire and interviewed many of the survivors. He emphasizes the extreme dryness that prevailed, the presence of vast areas of logging slash, the debris left by the fire of 1871, the prevalence of land-clearing fires, and the occurrence of winds of hurricane force, all of which combined to produce the holocaust which resulted. There have been bad fires in Michigan since, but none as severe or extensive as the great fires of 1871 and 1881.

The Fires of 1894

Eighteen ninety-four was another dry year. Disastrous forest fires raged in New York and Wisconsin. In Minnesota, the town of Hincley was wiped out with a loss of 418 lives, and "hardly a county in Upper or Lower Michigan escaped." The total area burned in Michigan was never estimated, but fragmentary reports indicate that fires were particularly bad in the vicinity of Ishpeming, Iron Mountain, Norway, Salisbury, Sagola, Floodwood, and Ewen, in the Upper Peninsula. As in 1881, these fires reached their peak in early September, following prolonged drought, and like most big fires burned until extinguished by heavy rains.

The Ontonagon Fire of 1896

The summer of 1896 also was unusually dry, especially in the Upper Peninsula. As early as August 25, the "Detroit News" reported that "forest fires have gained terrible headway in the vicinity of Trout Creek." On the twenty-ninth Rockland, Greenland, and Bessemer were threatened. On September 12, the town of Ontonagon, with its sawmill and lumberyard, was wiped out. For two weeks fires had been burning unchecked in the swamps back of town. On the twelfth, the wind freshened and by noon was blowing a gale from the south. Sparks from the fires in the swamp set fire to the sawmill and soon the lumberyard was ablaze. From here it spread to the town which was largely consumed. Only one life was lost, however.

In October of the same year a fire started on Dead River north of Ishpeming and burned through to Lake Superior in the vicinity of Big Bay "denuding the mountains" and covering an estimated 100 square miles of the virgin wilderness. As there was no organized protection and few tools available all the few settlers could do was to backfire around their clearings when the fire threatened, in an attempt to save their property. As a result, this fire burned unchecked for 10 days until the fall rains put it out.

The Metz Fire of 1908

Nineteen hundred eight was another dry year. In British Columbia, the Fernie fire burned over 64,000 acres with the loss of nine lives. In Minnesota, a 20,000-acre fire destroyed the town of Chisholm. Bad fires were also reported in Ontario. In Michigan, a disastrous fire occurred on Isle Royale, September 10. The drought was temporarily broken by rains the last four days of the month and it was believed that the danger of fires was passed for the year. Several killing frosts and lack of rain in October, however, resulted in their breaking out again, and on October 15 the town of Metz was destroyed with a loss of 29 lives. Seventeen of these were burned to death when a relief train, on which they were trying to escape, attempted to run a gauntlet of burning posts and poles piled along the track. The intense heat, however, caused the rails to spread and the train and its passengers were consumed. Incomplete reports placed the area burned in 1908 at 2,369,067 acres, the damage at \$2,570,446, and the cost of fire fighting at \$61,287.

Au Sable-Oscoda Fire of 1911

The last big Michigan fire in which a community was destroyed occurred on July 11, 1911, when slashing fires in Iosco County wiped out the sawmill towns of Au Sable and Oscoda at the mouth of the Au Sable River, with the loss of a score of lives and damage amounting to over \$3,000,000. There have been larger fires since, but none in which the loss of life and property was as great. The tragic Metz and Au Sable-Oscoda fires coming so close together did much to awaken public interest and to stimulate forest fire control. "Remember Metz and Au Sable" became a fire prevention slogan that helped materially to keep public interest alive and to secure support for more adequate protection efforts.

While there have been no catastrophic forest fires in Michigan since 1911, there have been numerous bad fires and 1915, 1919, 1921, 1923, 1925, 1930, 1931, 1933, 1936, 1946, and 1947 stand out for the number and severity of forest fires occurring. In 1925, for example, there were 132 fires over 1,000 acres in size; in 1930, 51; and in 1931, 53. While only 10 fires exceeded 1,000 acres in 1936, one of these, the Green School fire, will long be remembered for its severity and difficulty of control.

A partial list of the larger fires that have occurred since 1923 follows:

1923

Fifty thousand acres burned over in the vicinity of Silver City, Ontonagon County.

1924

On October 26, an 8,000-acre fire occurred in Roscommon County and a 6,000-acre fire in Ottawa County.

1925

May 3, Gogebic County, 15,800 acres burned, loss \$3,250.
May 11, Ontonagon County, 6,500 acres, loss \$14,000.
May 12, Iron County, 7,320 acres, loss \$3,000.
May 12, Cheboygan County, 10,700 acres, loss \$2,800.
May 12, Otsego County, 5,680 acres, loss \$3,000.
May 15, Alger County, 5,120 acres, loss \$4,980.
May 15, Montmorency County, 5,500 acres, loss \$115.
May 18, Cheboygan County, 9,000 acres, loss \$200.
May 19, Alcona County, 5,100 acres, loss \$1,300.
May 21, Gogebic County, 12,070 acres, loss \$6,020.
May 30, Presque Isle County, 6,240 acres, loss \$6,200.
May 31, Oscoda County, 8,800 acres.
June 1, Ogemaw County, 21,320 acres, loss \$20,000.
July 19, Schoolcraft County, 16,640 acres.
July 22, Alger County, 16,300 acres, loss \$8,300.
August 5, Chippewa County, 5,694 acres, loss \$10,550.
August 20, Antrim County, 6,900 acres.
August 22, Crawford County, 24,480 acres, loss \$5,100.
August 23, Kalkaska County, 6,500 acres.
August 31, Mackinac County, 5,280 acres, loss \$4,240.

1926

May 5, Dickinson County, 5,280 acres, loss \$3,200.
May 16, Oscoda County, 24,480 acres, loss \$3,000.
May 28, Marquette County, 9,520 acres, loss \$500.
July 8, Kalkaska County, 7,190 acres, loss \$1,500.

1928

May 9-12, Crawford County, 15,475 acres, loss \$19,330.
May 9-16, Alcona County, 5,730 acres, loss \$3,314.
June 12-20, Antrim County, 5,703 acres, loss \$4,346.

1930

June 1-4, Lake County, 5,650 acres, loss \$3,442.
August 1-September 16, Ontonagon County, 3,058 acres, loss \$4,069.
August 1-September 26, Menominee County, 3,550 acres, loss \$9,402.
August 8-31, Camp 33 Fire, Schoolcraft County, 4,994 acres, loss \$4,494.
August 8-September 12, Mackinac County, 7,490 acres, loss \$2,368.
August 10-September 15, Driggs Fire, Schoolcraft County, 20,936 acres, loss \$18,620.
August 21-31, Cheboygan County, 6,003 acres, loss \$1,353.
August 22-September 15, Newaygo County, 3,960 acres, loss \$7,992.
August 27-September 8, Clare County, 5,330 acres, loss \$4,962.
August 27-September 30, Mackinac County, 1,110 acres, loss \$307.
August 31-October 13, Roscommon County, 5,800 acres, loss \$6,010.
September 19-October 15, Missaukee County, 13,220 acres, loss \$10,565.

1931

April 17-25, Iron County, 6,030 acres, loss \$2,273.
August 13-October 7, Ontonagon County, 5,666 acres, loss \$8,124.
August 18-September 25, Duck Creek Fire, Schoolcraft County, 11,130 acres, loss \$13,322.
September 11-October 6, Keweenaw County, 5,230 acres, loss \$5,193.

1933

August 5-September 29, Horseshoe Lake Fire, Delta County, 2,425 acres, loss \$2,730.
August 20-September 7, Pomeroy Lake Fire, Gogebic County, 14,027 acres, loss \$13,711.
August 30-September 7, Bergland Fire, Ontonagon County, 13,252 acres, loss \$17,255.
September 2-9, Lovells Fire, Crawford County, 31,125 acres, loss \$23,570.
September 2-12, Deward Fire, Crawford County, 8,220 acres, loss \$4,937.

1934

June 1-8, Flynn Valley Fire, Alcona County, 7,200 acres, loss \$4,204.

1936

July 18-August 15, Green School Fire, Schoolcraft County, 9,343 acres, loss \$25,291.

July 20, Luce County, 2,400 acres, loss \$3,437.

July 23-August 23, Isle Royale (National Park), 36,000 acres.

July 29-August 28, Traunik Fire, Alger County, 3,824 acres, loss \$3,818.

August 1, Marquette County, 1,597 acres, loss \$629.

August 8, Echo Lake Fire, Marquette County, 1,702 acres, loss \$366.

1937

May 2, Presque Isle County, 36,000 acres, loss \$4,160.

1939

May 6-7, Canada Creek Fire (Presque Isle State Forest), Montmorency County, 28,556 acres largely plantations, loss \$166,378.

May 6-7, Grass Lake Fire, Montmorency County, 5,376 acres, loss \$21,197.

1940

April 16, Montmorency County, 2,520 acres, loss \$8,499.

1942

April 23, West Branch Township Fire, Marquette County, 4,271 acres, loss \$7,773.

1943

October 6, Marquette County, 1,200 acres, loss \$3,281.

1944

August 2, Sanilac County, 1,185 acres, loss \$9,937.

1945

March 28, Oscoda Fire, (Huron National Forest) Iosco County, 4,318 acres (1,992 acres plantations), loss \$43,115.

March 27, Stearns Siding Fire (Manistee National Forest), Lake County, 8,804 acres, loss \$44,760.

1946

April 2, Mack Lake Fires (Huron National Forest), Oscoda County, 16,772 acres, loss \$147,986.

May 28, Horseshoe Lake Fire, Ogemaw County, 1,960 acres, loss \$13,064.

1947

August 11-15, Presque Isle River Fire, Gogebic County, 2,115 acres, loss \$3,893.

October 16, Little Girl Point Fire, Gogebic County, 1,704 acres, loss \$11,765.

October 19, Lac La Belle Fire, Keweenaw County, 3,075 acres, loss \$56,392.

While a more or less systematic record of forest fires has been kept since 1911, not until 1925 is the record anywhere near complete. Table 1 summarizes the data available by years.

Table 1.—Forest fire record, Michigan—1871-1949¹
FRAGMENTARY DATA

Calendar year	Number of forest fires reported	Area burned	Damage reported
		Acres	Dollars
1871.....	.....	2,000,000	.....²
1880.....	267	238,270	985,980 ³
1881.....	.....	1,000,000	2,300,000 ⁴
1896.....	.....	228,000	1,250,000
1908.....	.....	2,369,070	2,570,450
OFFICIAL RECORD ⁵			
1911.....	191	156,480	3,465,860
1912.....	139	40,170	66,100
1913.....	.....	(No record)	.....
1914.....	935	408,765	97,714
1915.....	632	157,622	155,113
1916.....	497	283,300	33,103
1917.....	479	193,934	102,368
1918.....	704	238,122	114,183
1919.....	862	418,359	406,856
1920.....	560	76,445	405,991
1921.....	1,028	283,641	296,390
1922.....	538	38,483	35,265
1923.....	1,336	466,474	534,811
1924.....	1,936	242,956	149,766
1925.....	3,887	733,750	475,115
1926.....	1,524	145,060	101,730
1927.....	2,394	94,720	71,050
1928.....	1,340	67,150	59,970
1929.....	2,457	51,920	54,230
1930.....	4,690	290,300	279,160
1931.....	4,282	284,940	189,690
1932.....	2,635	40,840	17,990
1933.....	4,721	205,370	173,870
1934.....	3,300	54,680	34,500
1935.....	1,696	19,280	18,300
1936.....	3,010	97,790	2,827,220
1937.....	1,564	19,500	41,870
1938.....	1,561	20,970	41,960
1939.....	1,566	48,330	271,030
1940.....	1,072	18,442	33,008
1941.....	1,658	11,054	28,970
1942.....	1,080	17,875	59,318
1943.....	909	19,795	61,499
1944.....	1,758	24,672	79,705
1945.....	1,124	36,816	181,208
1946.....	2,263	44,328	249,017
1947.....	1,804	26,900	162,267
1948.....	2,094	18,071	118,470
1949.....	1,964	24,974	128,708

¹Includes both State and National forest fires.²The year of the Great Michigan Fire.³Tenth Census report.⁴The year of the Thumb Fire.⁵From FOREST FIRE STATISTICS compiled by the Division of Cooperative Forest Protection—Forest Service, U. S. Department of Agriculture, Washington, D. C. Data incomplete prior to about 1930.

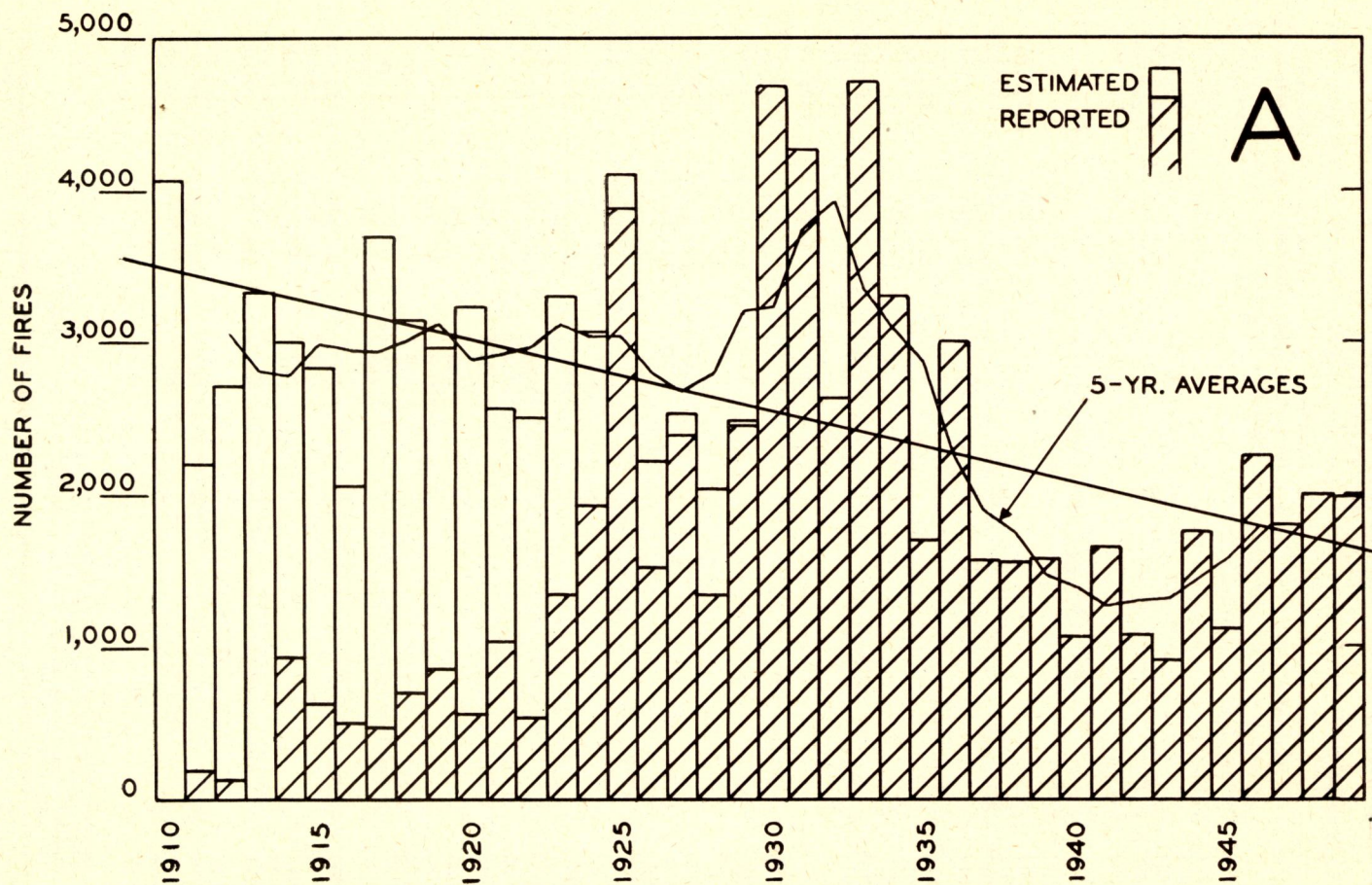
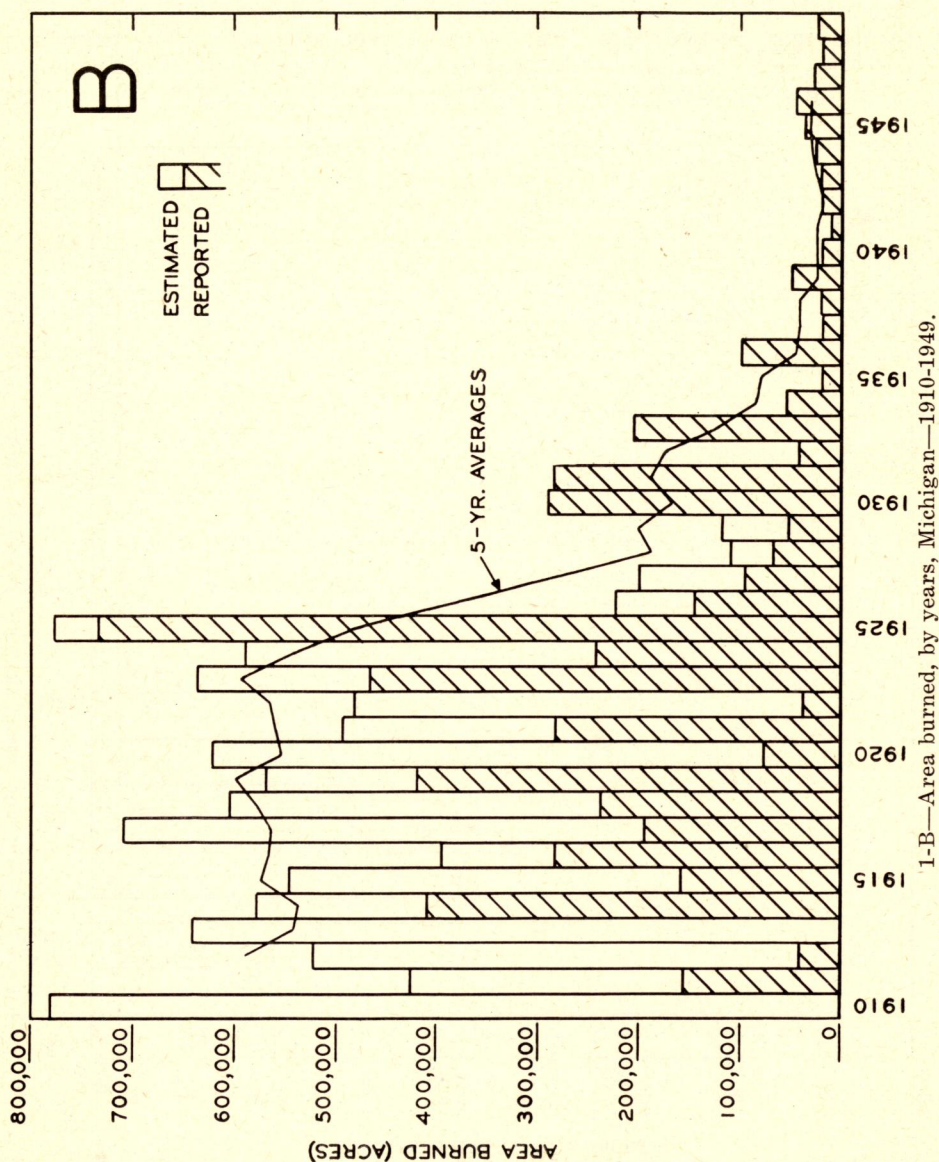


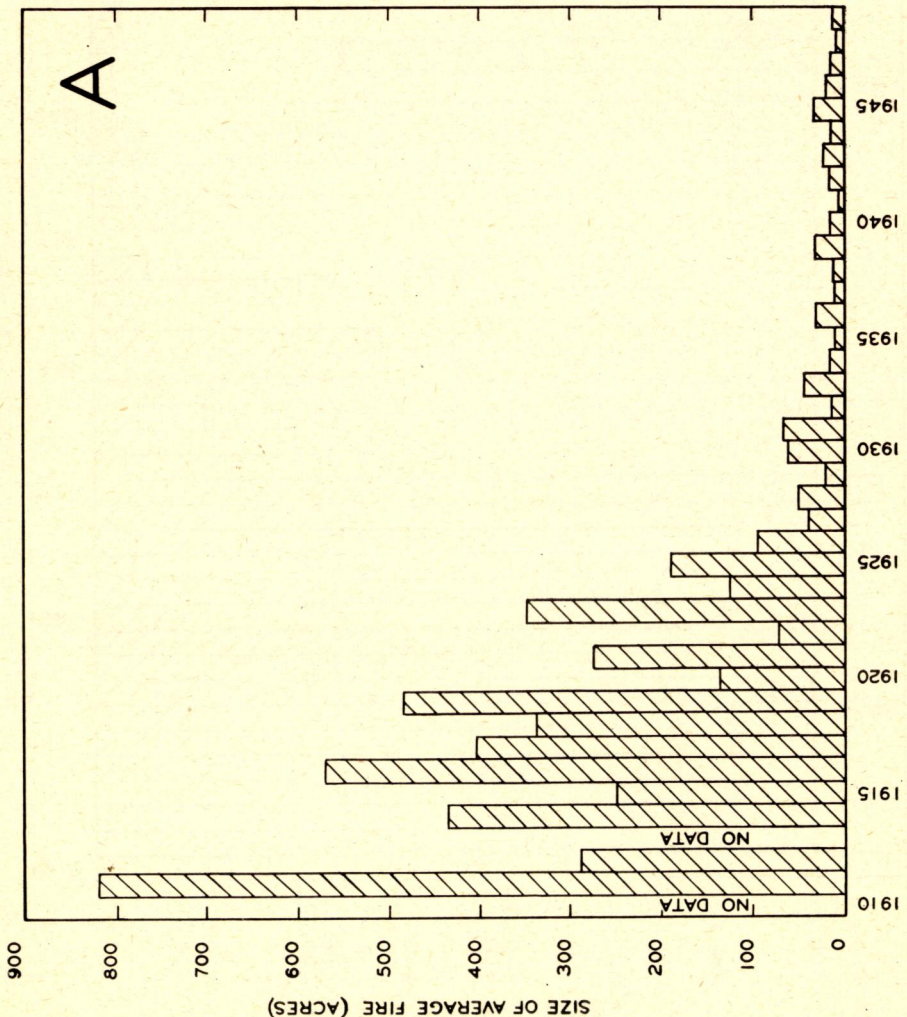
Figure 1-A—Number of forest fires, by years, Michigan—1910-1949.

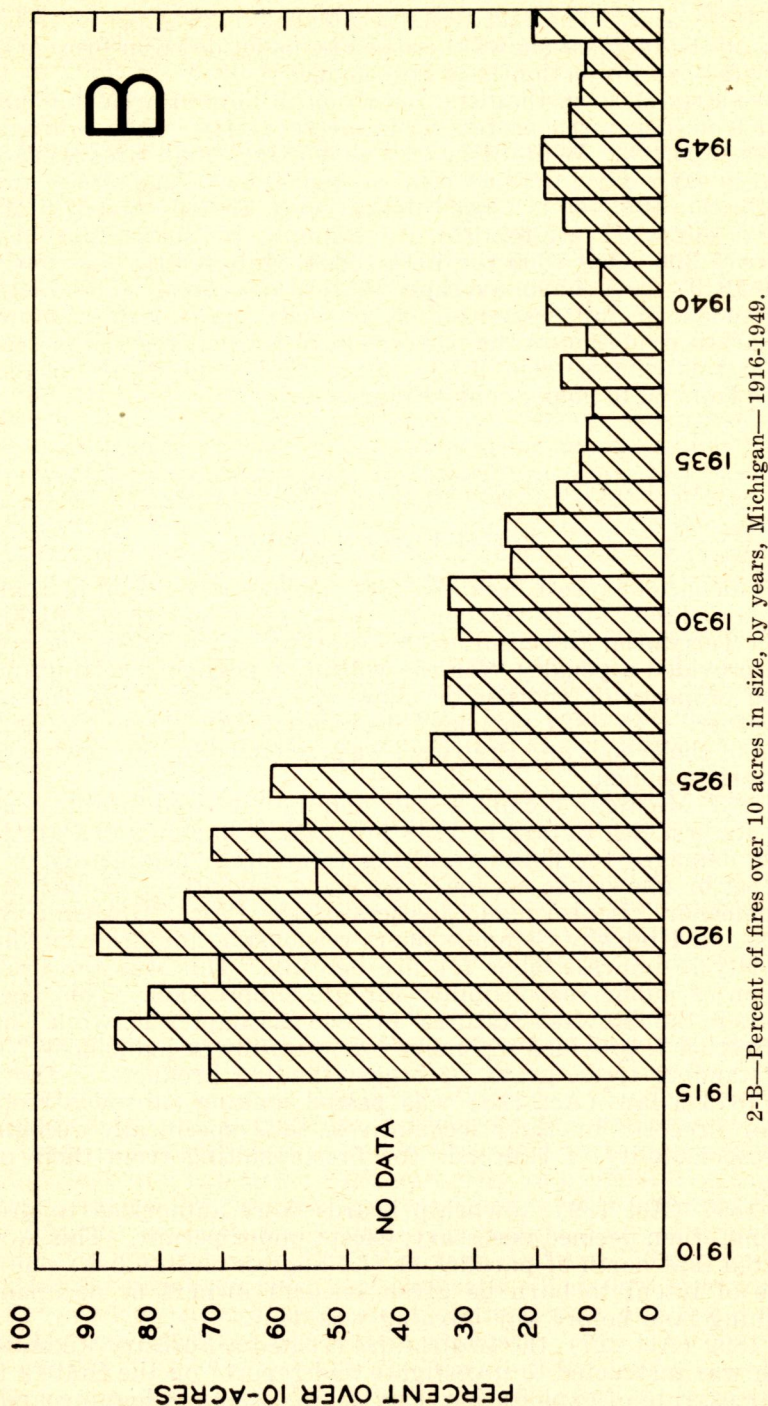
Since 1925 the number of fires per year has ranged from 909 in 1943 to 4,721 in 1933. Although the number of fires varies widely from year to year, depending on weather conditions, the over-all trend since organized protection has been in effect has been downward. Based on the 10-year period (1939-1948), which is fairly representative of present conditions, the average number of fires per year is just over 1,500 (1,524) for the state as a whole. Figure 1-A shows



the estimated and reported number of fires per year since 1910, the over-all trend, and the current trend, based on five-year averages.

Like number of fires, area burned varies from year to year with the dryness of the season. It also directly reflects the effectiveness of fire control effort (Figure 1-B). Prior to 1925, for example, it is estimated that the average annual burn amounted to over half a million acres (572,915 for 1910-1925) while it now averages only a little over 25,000 acres (26,483 for 1939-1948), or about one tenth of one per cent (0.107) of the area protected. Since an average annual burn of two tenths of one per cent is generally considered allowable, protection in Michigan on the whole may be considered adequate. The problem remains, however, of maintaining the present degree of effectiveness, of eliminating large fires, and of coping with emergency conditions





when they arise. The fact that the number of fires per year is currently on the increase shows there can be no let down in present effort if satisfactory protection is to be provided.

More striking even than the reduction in burned area that has resulted from organized protection is the reduction in the average size of fires reported. While it is true that many small fires were overlooked in early days, the fact remains that the average size of fires on which action is taken is a good indication of the effectiveness of suppression effort. Prior to 1925, for example, the fires reported averaged over 300 acres (305 for 1911-1924) while for the last ten years (1940-1949) fires have averaged only 14.8 acres. The increased effectiveness of suppression effort in recent years is also shown by the marked reduction in the per cent of fires over 10 acres in size. At present this ranges from 17 to 25 per cent while, prior to 1925, it ranged from 55 to 90 per cent (Figure 2).

THE DEVELOPMENT OF PROTECTION EFFORT

Forest Fire Legislation

The menace of forest fires was first officially recognized in Michigan by a law signed on November 25, 1817, by Lewis Cass, Michigan's fourth Territorial Governor. This statute, taken from the laws of Ohio, provided a penalty "for the willful or negligent setting of fires on the property of another or allowing fire to escape to the injury of another." In 1827 this law, designated "An act to Prevent the Firing of the Woods and Prairies," was reenacted by the newly created Territorial Council.

In 1837, Michigan became a state and the "Revised Statutes" adopted by its first Legislature in 1838 provided (Chapter 9 of Part I) for double damages for losses resulting from fires "negligently or willfully set or allowed to escape" and made the setting of such fires a misdemeanor. It also made Justices of the Peace, Township Supervisors, and Highway Commissioners responsible for fire control with authority to impress labor for fire fighting. This was the first recognition of public responsibility for fire suppression. This law also appears in the "Revised Statutes" of 1846 as Chapter 45, while Chapter 154, Section 7, provided a penalty for "willfully or maliciously" burning "standing trees, grass, or other standing products of the soil."

In 1873 a law (Act 198) was passed making railroads responsible for fires set by their locomotives, thus specifically recognizing the responsibility of railroads for fires resulting from their operations.

In 1897 (Act 189), township boards were authorized to prohibit burning, when deemed necessary, except under permit. This Act also required that north of parallel 44 (Ludington to Standish) one day's notice of intent to burn be given resident owners or occupants of adjoining land before any burning was done.

In 1899 (Act 227), the Legislature created a Forestry Commission, which was instructed to investigate and report "on the State's forest resources, rate of exploitation, loss by fire, waste in logging and land

clearing, effect of cutting on climate and weather and to recommend remedial legislation." The commission was also instructed to recommend 200,000 acres of State tax delinquent homestead and swamp lands for withdrawal as forest reserves. In 1903 (Act 175), the first state forest reserves (now the Higgins Lake and Houghton Lake State Forests) were established in Roscommon and Crawford counties, and the Forestry Commission was authorized to provide for their maintenance, management, and regulation. This included protection from fire and marks the beginning of state fire suppression effort.

The first comprehensive forest fire law (Act 249) was passed by the Legislature in 1903. By this law State participation in forest-fire control outside of the state forests was authorized, the State Land Commissioner being designated Forest Commissioner with authority "to prevent, suppress, and report on fires north of Township 20 (about half way between Ludington and Manistee)" and to appoint a chief fire warden at \$500 a year. Township supervisors, mayors of cities, and village presidents were made ex-officio fire wardens, and the employment of temporary fire wardens was authorized. The pay of fire wardens was set at \$2.00 a day for not to exceed 15 days a year (temporary fire wardens five days), payment to be made by the township boards and the State to reimburse the townships for one-third of the expense incurred up to a total of \$5,000 a year, but not over \$50 to any one township.

This law authorized fire wardens to prevent and suppress fires, impress fire fighters, arrest fire law violators, post abstracts of the fire laws, and report on fires. Penalties were provided for careless, negligent, or willful setting of fires, allowing fires to escape, leaving fires unquenched, refusing to fight fires, and for defacing fire signs; and railroads were required to provide efficient spark arresters, keep rights-of-way clear of inflammable material, extinguish fires along their lines, post fire warnings in stations, and were prohibited from depositing live coals or hot ashes on their rights-of-way in the vicinity of woodlands. (Woodland was defined as including brushland.)

Spark arresters were also called for on portable steam engines, and their operators were required to cover hot ashes with earth. No appropriation, however, was made to finance this Act, hence nothing was done.

In 1907 (Act 106), the positions of Forest Commissioner and Chief Fire Warden were abolished, and the powers and duties of these officers were transferred to the State Game, Fish, and Forestry Warden (Formerly the State Game and Fish Warden). Another Act (Act 317) passed by this Legislature, authorized the employment of not more than 10 district deputy game, fish, and forestry wardens, at \$1,000 a year and expenses; with authority to oversee township fire wardens, employ fire fighters, impress labor, and to enforce the fire laws. By this law also, the limit on the State's share of fire control expenditures was raised to \$10,000 a year, and the \$50 per township limitation for reimbursement was abolished. This law also provided that fines and penalties for fire law violations were to be paid to the townships concerned for fire control expenses.

By Act 294, P. A., 1911, the Public Domain Commission, established in 1909 to succeed the old Forestry Commission, was reorganized and

made responsible for forest fire control. In effect this made the State Game, Fish, and Forestry Warden responsible to the Public Domain Commission for forest protection activities. The result was confusion as to authority and considerable inter-departmental bickering. To remedy the situation, the Legislature in 1913 (Act 333) specifically relieved the State Game and Forestry Warden of responsibility to the Public Domain Commission, and changed his title to Game, Fish, and Forest Fire Commissioner. In 1915 (Act 28), the State Game, Fish, and Forest Fire Commissioner was taken over by the Public Domain Commission, and the authorization for fire suppression was raised to \$20,000 a year.

The basic forest fire law passed in 1903 and amended in 1907 was again amended by Acts 221, 300, 364, P. A. 1917, to increase the limit on State expenditures for fire control to \$40,000 a year to pay special deputy game, fish, and forest fire wardens from \$2.50 to \$4.00 per day, and to increase the period of allowable employment of fire wardens from 15 to 25 days a year, and of fire fighters from five to 10 days or longer in any emergency, when specifically authorized. To expedite the settlement of fire fighting bills, the State also was authorized to pay fire fighting costs direct, and to charge back one-third to the townships concerned. In 1919, however, (Act 41) township treasurers were again made responsible for paying fire fighters, but could bill the State for three-fourths of the cost. Act 153, P. A., 1919, again increased the limit on state expenditures for fire fighting, this time to \$50,000 a year.

The present State Department of Conservation was established by Act 17, P. A., 1921, and took over the powers and duties of the Public Domain Commission along with those of various other agencies, and in 1923 (Act 143) the old forest fire law of 1903 as amended, was broadened to extend protection to the entire state, and to provide for the appointment of a chief fire warden under the supervision of the Director of Conservation, and of district deputies and assistant fire wardens as needed. The most important change, however, was the elimination of ex-officio local fire wardens and the assumption by the State of all fire control responsibility and costs. In addition, the restriction on the amount the State could expend for fire suppression was removed, as well as the limit on the period of employment of wardens and fire fighters. This basic law, with minor changes, remains in effect today and is an outstanding example of progressive state forest fire legislation.

In 1925 a burning permit law (Act 341) was passed, which specifically prohibits the setting of fires for other than domestic purposes, unless the ground is snow covered or a fire line has been plowed around the area in question, except under permit issued by a conservation officer, authorized township supervisor, or designated elective official. The Conservation Department was also empowered to prescribe regulations as to how and when burning may be done and to revoke permits issued when extreme conditions prevail.

In 1927 (Act 26), a highway slash-disposal law was enacted requiring the disposal of slash and inflammable material within 100 feet (later changed to 50 feet) of highways and public utility rights-

of-way, and the Department of Conservation was authorized to dispose of such material, if necessary, at the expense of the operator.

In 1929 (Act 139), the Department of Conservation was authorized to contract with railroads, landowners, counties, and townships, for the construction and maintenance of permanent fire breaks "provided that the State shall not be obligated for more than 50 percent of the cost." While not taken advantage of to any great extent to date, this law opens the way for the active cooperation of the State in reducing fire hazards.

In 1935 (Act 29), the Forest Fire Law of 1923 was amended by the addition of Section 6 which provides that the Governor may forbid by proclamation the use of fire in woodland areas when conditions warrant and specifically prohibit the building of campfires or smoking in areas closed, except at specified campgrounds, in places of habitation, or in automobiles operating on highways and roads. In addition it prohibits the throwing of lighted matches or smoking materials from vehicles operating on roads or highways, and the burning of slash, rubbish, or stumps when clearing land or right-of-way, without a written permit from a duly authorized official.

The latest change in the state forest fire law was made in 1949 (House Bill No. 173) which amends Section 7 and adds Section 13a. In effect this law limits the issuing of burning permits to conservation officers and persons specifically authorized by the Conservation Commission and makes any one allowing a fire to escape through negligence liable for the cost of suppression other than the time and expenses of conservation officers, and use of state-owned suppression equipment. (Table 2.)

Early Protection Efforts

Forest protection in Michigan has come a long way since the menace of forest fires was first officially recognized in 1817 and local authorities were made responsible for their control in 1838. Ideas also have changed. For years fires were looked on with indifference except when they threatened life or property and were considered more or less inevitable. They have now come to be recognized as an unnecessary economic waste and a threat to the prosperity and well being of the State. As late as 1923, however, efforts to control fires were still largely confined to the protecting of life and property of recognized value. As a rule, no effort was made to stop fires unless they threatened improvements or merchantable timber, then back fires would be set to head them off. Sometimes these back fires accomplished their purpose but often they served only to spread the fire and frequently did more damage than good. As a result of this attitude toward forest fires, lack of interest on the part of local fire wardens, and the reluctance of township boards to spend money for fire fighting, fire control effort was largely ineffective. Not until it was learned from bitter experience that the only way to control fires was to prevent them or to put them out while small, regardless of where they were or how harmless they might appear, did fire control begin to be effective.

Organized protection effort dates from 1907, when Charles S. Pierce, then State Game and Fish Warden, was made Game, Fish, and For-

Table 2.—Funds available and expended for the protection of state and private lands from fire, Michigan

Fiscal year	State appropriation	Federal aid	Total expended ¹
1903.....	\$5,000 a year authorized to reimburse townships for one-third of expense incurred for fire suppression.		
1907.....	Fire suppression authorization increased to \$10,000.		
1914.....	\$ 10,000 ²	\$.....	\$ 11,223
1915.....	10,000	1,570	11,724
1916.....	20,000	1,134	42,974
1917.....	20,000	4,197	39,370
1918.....	40,000 ³	3,555	69,653
1919.....	40,000	4,280	65,198
1920.....	50,000 ⁴	2,110	62,696
1921.....	50,000	7,240	97,584
1922.....	75,000	25,000	165,367
1923.....	75,000	22,786	160,788
1924.....	225,000 ⁵	22,164	263,856
1925.....	225,000	23,935	366,193
1926.....	250,000	48,310	254,314
1927.....	232,500	37,080	382,583
1928.....	294,550 ⁶	54,804	359,115
1929.....	384,300	77,694	385,200
1930.....	318,300	81,410	569,392
1931.....	308,300	135,351	903,558
1932.....	279,700	131,320	655,119
1933.....	304,250	119,871	402,707
1934.....	207,000	107,440	606,649
1935.....	207,000	105,700	527,725
1936.....	294,250	93,425	379,916
1937.....	310,000	108,515	567,225
1938.....	464,000	92,726	560,300
1939.....	559,325	113,775	610,622
1940.....	381,526	130,815	610,827
1941.....	381,526	128,554	582,791
1942.....	384,500	136,100	673,043
1943.....	408,000	177,722	679,468
1944.....	417,000	248,959	824,160
1945.....	416,000	318,682	924,216
1946.....	490,000	445,189	1,005,274
1947.....	556,260 ⁷	503,506	1,252,009
1948.....	516,885	416,331	933,216
1949.....	625,955	464,129	1,090,084
1950.....	684,529	431,640	1,116,169

¹Emergency expenses financed out of fire suppression and other funds included. ²Authorization for fire suppression increased to \$20,000 a year. ³Authorization for fire suppression increased to \$40,000 a year, the State to pay two-thirds of township costs. ⁴Authorization for fire suppression increased to \$50,000 a year, the State to pay three-fourths of township costs. ⁵Department of Conservation authorized to pay all fire suppression costs out of the General Fund. ⁶Starting with 1928, \$50,000 for fire suppression included in regular appropriation. ⁷Starting with 1947, \$100,000 for fire suppression included in regular appropriation.

estry Warden and the State assumed part of the expense of fire suppression. Under authority of Act 106 of 1907, the state north of township 20 was divided into 10 districts and district deputy game, fish, and forestry wardens were appointed. They functioned primarily as game wardens, but forest fire warnings were posted and township fire wardens were encouraged to take action on fires. In 1908 an attempt was made to compile by counties and kind of land involved, statistics as to the area burned and the damage resulting from the fires that burned that year. These are the first official forest fire statistics published by the State. A survey made of the fire district (the part of the state north of Township 20) at this time placed the area in need of protection at 15,530,080 acres.

The inadequacy of state and local protection effort and the heavy fire losses sustained in 1908, led a number of the larger timber operators to undertake the protection of their own holdings. This resulted in the organization on November 5, 1910, at Marquette, of the Northern Forest Protective Association, and the appointment of Thomas B. Wyman, Forester for the Cleveland Cliffs Iron Company, as secretary and chief forest fire warden. The purpose of this organization, as stated in its constitution, was "the preservation of the forests of the states of Michigan and Wisconsin generally and particularly from loss by forest fires, and the enlistment of the aid of the United States of America and the states of Michigan and Wisconsin in preserving said forests and preventing their destruction by fire. . . ." By July 14, 1911, this organization had 19 wardens patrolling in Gogebic, Ontonagon, Baraga, Iron, Dickinson, Marquette, Alger, and portions of Houghton, Schoolcraft, Menominee, and Delta counties. These wardens were charged with the duty of posting fire signs, contacting lumbermen and farmers, and securing cooperation in burning and in "watching fires" to see that they did not escape. They also fought such fires as they could and attempted to get action on others.

As a rule, these wardens traveled on foot, horseback, train, railroad speeder, or by horse and buggy. The roads, however, were bad, and it often took as long as 10 hours to reach a fire after it was reported. As a result, their efforts at fire suppression were not too effective but did help to awaken interest in fire control, especially among timberland owners, and to stimulate state and local protection effort. The expenses of the Association were met by a per-acre assessment against lands listed by its members. The original assessment was one cent an acre per year, but was later raised to one and one-eighth cents. Fire fighting expenses were reported to the local township boards, and in most cases were paid by them. Some townships, however, balked, due to the delay and difficulty of securing the one-third reimbursement from the State provided for by law.

While the primary responsibility of the association wardens was to protect the property and lands listed by association members, it was found necessary to take action on unlisted lands as well in order to keep fires under control. This was especially true since there was a tendency on the part of members to contribute only for areas of merchantable timber leaving cut-over lands unprovided for in spite of the fact they presented the greatest hazard.

To facilitate the work of the Association wardens and give them

legal status, Major Oates, then State Game, Fish, and Forestry Warden, commissioned them, as well as some 26 woods superintendents and camp foremen of association members, special fire wardens with authority to arrest for fire law violations and to impress fire fighters. Permission was also given the association to post fire signs of their own and state fire warnings, with the notation that "these lands are patrolled by the wardens of the Northern Forest Protective Association."

In 1914 a similar association was organized in the Lower Peninsula under the auspices of the Northern Hardwood Manufacturers Association, with headquarters at Gaylord, and with Charles Hickock as Chief Warden. This association was less formally organized than the Northern Forest Protective Association, and depended on current assessments to meet its bills. These two associations were active until 1917, when the State took over the responsibility for forest fire control. The Northern Forest Protective Association finally disbanded in 1921. During its existence it collected in assessments some \$16,665 from its members, of which \$10,222 was expended, the balance being returned to the contributors.

Major William R. Oates succeeded Mr. Pierce as State Game, Fish, and Forestry Warden in 1911. Realizing that until public interest was aroused to the need of forest fire control that efforts to control fires were futile, a lecturer and photographer, James H. McGilivray, was employed as Special Deputy in charge of Education and, with a Deputy Forestry Warden, was assigned to give lectures in schools and before various groups throughout the state. During a 40-week period, 402 lectures on forest fire prevention and 108 on wildlife were delivered and the lectures were translated for publication in Finnish, Italian, Romanian, Serbian, and Hungarian in an effort to reach the State's foreign-speaking population.

At the suggestion of Governor Chase S. Osborn, the Michigan Forest Scouts were organized in September 1911 for "the protection of frontier life and property and reforestation." Boys from 8 to 18 residing in or near the forest area of the state were recruited and organized in local groups under the supervision of the district wardens. A "Forest Scout Text Book" was prepared for their instruction and they were given badges and appointed auxiliary Fire Wardens. In 1912 it was reported that 2,500 (5,000 in 1914) had been enrolled and that they had "extinguished or reported 509 fires, 56 without adult aid, at least 3 of which would have taxed the ingenuity and intelligence of the best men fire fighters." Obviously this did not solve the fire control problem, but it did much to arouse interest, help educate the public, particularly the younger generation, and stimulate protection effort. The organization, however, was short-lived and by 1915 had passed out of the picture.

More enduring was the start made by the State in the enforcement of the railroad fire law. In 1912 John A Higgins was appointed Acting Inspector of Locomotives and Rights-of-Way. Since that date the State has not been without a railroad fire inspector.

About this time also the State first resorted to law enforcement as a means of discouraging the willful and careless setting of forest fires;

16 cases of fire law violation and 12 convictions being reported in 1911, and 10 cases with nine convictions in 1912.

As a result of the public interest aroused by the Au Sable-Oscoda fire in 1911, a Forestry Congress was called by A. C. Carton, Secretary of the Public Domain Commission, to which leading lumbermen, educators, and others interested, were invited. This Congress met in Lansing on June 12, 1912, and was well attended. An appropriation of \$50,000 a year for forest fire prevention was recommended, and it was proposed that conservation education in the public schools be required. It was also recommended that legislation be passed providing for a special deputy (forest fire) warden, an inspector of railroad locomotives and rights-of-way, and a field supervisor of forestry.

The State's first full-time fire officer, William J. Pearson, was appointed in 1914 by Major Oates. As Chief Forest Fire Warden "Bill" Pearson pioneered the development of the State's fire control organization and both then and later as State Senator and as a member of the Conservation Commission did yeoman service in the cause of conservation. With only the part-time help of the district game, fish, and forest fire wardens and a handful of temporary patrolmen, lookouts, and fire wardens, at his disposal there was little that he could do in the way of actual fire suppression beyond encouraging local fire wardens to take action. An effort was made, however, to protect settlements, merchantable timber and improvements and some good was accomplished. More important, a start was made in the development of a system of lookout towers and telephone lines for detecting and reporting fires which paved the way for more effective protection.

The greatest handicap to effective forest fire protection at this time was public indifference and, on the part of many, active antagonism to forest fire control, since it was widely held that forest fires stimulated agricultural development. The early settlers had had to destroy the forest and clear the land to make room for their crops, and the farmer was still considered to be the logical successor to the lumberman. What was overlooked was the fact that much of the cut-over land was unsuited to agriculture and further that the short growing season prevailing in the northern part of the state was a handicap to successful farming. The lumbermen still in the cut-and-get-out stage also held and encouraged the idea that all land should ultimately be farmed and made every effort to sell their cut-over land to settlers. When they failed in this, the land was allowed to revert to the State for taxes and was bought up in large blocks by promoters and speculators who in turn resold it by high pressure sales methods to innocent buyers who tried and failed to make a living farming it. The State, itself, was guilty of encouraging this and only later came to realize the short-sightedness and futility of such a policy. This is another story, but the fact remains, that the mistaken idea that all cut-over land was destined for agricultural development long prevailed and made the development of effective forest fire control exceedingly difficult.

Another difficulty resulted from the fact that the state agency responsible for fire control was primarily concerned with game protection and looked on fire control as a minor and unwelcome responsibility. Not until forest protection was taken seriously and given the

emphasis it deserved was any material progress made in the development of an effective state fire control organization.

In 1917, at the urging of the Northern Forest Protective Association, Thomas Wyman, the Association's Secretary, was appointed Special Fire Warden for the Upper Peninsula, with authority over both State and Association fire wardens, the State and the Association both contributing to his salary. Under this arrangement Pearson confined his attention chiefly to the Lower Peninsula. The result was not too satisfactory due to jealousy and antagonism between State and Association wardens.

In 1919, Mr. Wyman resigned and Pearson assumed responsibility for forest fire control throughout the state. In the meantime the state appropriation for fire control had increased from \$10,000 in 1914 to \$20,000 in 1916, and to \$40,000 in 1918. The year 1919, however, was dry and fires raged throughout the state. Wyman's resignation in midseason left the protection organization in the Upper Peninsula at loose ends and more or less demoralized. In the Lower Peninsula conditions were not much better. The result was that beyond protecting threatened settlements little was accomplished.

Mr. Pearson resigned in 1920 and was succeeded by Charles Peterson, a former district warden, but no material change was made in the protection set-up and it continued to function much as it had in the past. Unification of the state protection effort under one head, however, led to better coordination and a growing sense of state responsibility. Progress also was made in the development of the State's fire detection system, lookout towers being built at strategic points, and many miles of telephone lines constructed.

The Department of Conservation was established in 1921, and absorbed the Public Domain Commission along with other related agencies. The revised forest fire law passed in 1923 providing for full state responsibility for forest fire suppression, and extending protection to the entire state, marked the beginning of effective effort in this direction. To take the place of the township fire wardens, which were done away with, "fire bosses" were employed on a per diem basis to organize local groups of fire fighters, and "keymen" were appointed in outlying areas to take action on fires reported to them or occurring in their vicinity. To supplement their efforts, seasonal fire wardens and lookouts were employed under the direction of the district wardens, while Charles Peterson, as Chief Warden, continued to direct the work as a whole.

While considerable progress had been made in fire detection, protection was still far from adequate. Equipment was crude or lacking, and methods of fire control primitive. Nor was the necessity for prompt action and complete suppression of fires fully realized. As a result, fires still averaged well over 100 acres in size and 75 per cent or more exceeded 10 acres before extinguished, while on the average, more than 2.5 per cent of the area protected burned over annually.

Not until 1927 did the State seriously attempt to solve its forest fire problem. In that year Fred W. Green succeeded Alexander Groesbeck as Governor and a new Conservation Commission was appointed. One of the first acts of this Commission was to appoint Leigh J. Young, a professor of forestry at the University of Michigan, Director of Con-

servation and Horace J. Andrews, an experienced forester, Chief Fire Warden.

Young was succeeded by George R. Hogarth as Director of Conservation in 1928, and he, in turn, by P. J. Hoffmaster, in 1934. Andrews remained as Chief Fire Warden until the Spring of 1930 when he resigned to re-enter the Federal Forest Service. Since 1927 the State's efforts at fire control have been increasingly effective, and today Michigan is recognized as having one of the most effective protection organizations in the United States. While more ample appropriations have made this possible and the modern equipment and techniques have helped materially, the able and progressive leadership of Andrews and his successors was largely responsible for the progress made.

The Federal Government first came into the picture in 1908 when some 83,157 acres of public land in Oscoda, Iosco, and Chippewa counties were set aside for national forest purposes. In February 1909 the Marquette National Forest in the Upper Peninsula and Michigan National Forest in the Lower Peninsula were created by Presidential order with a gross area of 30,603 and 133,609 acres respectively, and placed under the jurisdiction of the U. S. Department of Agriculture's newly established (1905) Forest Service. Headquarters were set up at Oscoda (moved to East Tawas after the 1911 fire) and the protection of federal and adjoining lands was undertaken. In 1915 these two units were combined as the Huron National Forest. The Marquette and Hiawatha Purchase Units, now administered as the Upper Michigan National Forest, were established in 1928 as was also the Keweenaw Purchase Unit, now the Ottawa National Forest. The Manistee Purchase Unit was created in 1933 and proclaimed a national forest in 1938. In 1947 the Huron and Manistee National Forests were combined for administrative purposes as the Lower Michigan National Forest. In 1949 there were five national forests in Michigan with a combined gross area of 5,142,726 acres of which 46 per cent or 2,353,406 is federally owned.

National Forests in Michigan, 1949

Forest	Gross land area	Federally owned—		
	Acres	Acres	Per cent	Headquarters
Ottawa.....	1,742,966	792,000	45	Ironwood
Hiawatha ¹	822,013	463,000	56	Escanaba
Marquette ¹	503,140	331,000	66	Escanaba
Huron ²	762,311	414,817	54	Cadillac
Manistee ²	1,312,296	352,589	27	Cadillac
Total.....	5,142,726	2,353,406	46	

¹Administered as Upper Michigan National Forest.

²Administered as Lower Michigan National Forest.

In 1911 Congress passed what is known as the Weeks Law. Among other things, this law authorized federal aid to the various states for fire protection on state and private lands "on the watersheds of

navigable streams." Michigan received its first federal allotment (\$5,000) under this law in 1914, but expended only 50 cents of it. Since 1915, however, federal funds have been of material assistance to the State in financing its fire control activities. In 1923, the Weeks Law was superseded by the Clarke-McNary Law which increased the amount available and broadened the scope of the cooperation offered. At present (1949) Michigan receives a federal allotment for fire protection of over \$400,000 annually.

An important contribution to forest fire protection in Michigan was also made by the Civilian Conservation Corps which functioned from 1933 to 1942. Under this program 70 federal and 56 state camps of approximately 200 men each were established. While they did not confine their activities wholly to forest fire control, this constituted one of their major activities. For example, 95 lookout towers, eight lookout cabins, 1,958 miles of telephone line, 24 airplane landing fields, 6,818 miles of truck trails, 55 miles of foot trails, and 1,371 miles of firebreaks were constructed for fire control purposes. In addition, 207,410 man-days were spent fighting forest fires, and 205,478 on fire prevention and suppression activities. Inflammable debris was removed from 4,705 miles of road and from 167,265 acres of high hazard land. More important, it was demonstrated beyond a doubt that with adequate manpower and equipment control of forest fires was entirely feasible.

Another activity which has contributed materially to forest fire protection is the work of oil field hazard reduction carried on by the State Department of Conservation since 1936. The fire hazard is naturally high in any oil field, but when, as in Michigan, the bulk of the operations are on lands subject to forest fires the danger of serious conflagrations becomes acute. Not only are gas and oil wells and storage facilities endangered by forest fires, but they are a potent source of forest fire as well due to their highly inflammable character. To ameliorate the situation, regulations were prescribed for the disposal of brine and oil waste, the construction of fire walls around tanks and wells, the removal of surrounding brush and trees, and other fire prevention measures. A supervisor and 10 inspectors are employed to enforce these regulations. The results have been highly satisfactory for not only has the number of oil field fires been reduced but there has been little damage to forest growth due to oil field fires during the past 10 years.

Education and Publicity

Public acceptance and support is essential to the success of any policy affecting the behavior of individuals in a free society. Except in a police state, laws are not enough. This has been particularly true in the case of forest fire control. In Michigan for example, little progress was made until the public generally was convinced of the desirability of protecting forest lands.

Much credit is due to the pioneer conservationists, the Honorable Charles W. Garfield of Grand Rapids, Dr. William J. Beal of the State Agricultural College, and Professor Filibert Roth of the University of Michigan among others, who first preached fire control along with

forestry and conservation in general to an uninterested and unresponsive public. As a result of these early efforts a "forestry convention" was sponsored by the State Board of Agriculture and held in Grand Rapids on January 26 and 27, 1888. The minutes of this meeting show that many prominent lumbermen were invited but that little interest was shown and only a few attended. Speaking for the lumbermen, Arthur Hill of Saginaw attributed fires primarily to land clearing and the railroads. While admitting that lumbermen were careless, he held that slash disposal was impractical.

As a remedy for the unsatisfactory conditions prevailing, Dr. Beal proposed that burning be regulated and burning permits required; that fires be prohibited within 200 feet of woodland unless a six-foot safety strip was cleared; that a 50-foot clearing be required around charcoal pits; that railroad rights-of-way be cleared; that fire lines be constructed through slash; that throwing away lighted matches and tobacco be prohibited; that township fire wardens be appointed; that fire warnings be posted; and that warning flags be displayed on trains and at signal stations during periods of fire danger. While nothing was done about it at the time, many of these suggestions were later adopted.

In 1905, the Michigan Forestry Association was organized at Grand Rapids for the purpose of promoting a "rational and practical system of forestry in Michigan, and the reclamation and use of lands, public and private, now unproductive, for the ultimate advantage of the State and its citizens." From 1905 to 1910, this organization was very active. It brought to the attention of the public the then deplorable condition of Michigan's cut-over lands; was influential in promoting the protection of forest land from fire; helped bring about a reform in State policy in regard to the use and disposal of tax delinquent land; and promoted the establishment of State Forests and the enactment of basic forestry legislation. From 1913 to 1923, the association languished, but in 1923 it was revived and played an important part in divorcing conservation from politics, and in promoting the employment of trained and experienced foresters in positions of responsibility.

The first fire sign used in Michigan was an abstract of the forest fire law posted by the State as required by the law of 1903. The use of publicity material calling attention to the losses resulting from forest fires and warning against carelessness with fire in the woods dates from 1911 and was pioneered in Michigan by the Northern Forest Protection Association. A number of their early posters appear in Figure 3. In addition to posters and fire warnings this association also got out a number of illustrated forest fire pamphlets for distribution to the general public at fairs and meetings, and supplied lumber camps with playing cards and book matches bearing forest fire slogans.

The widely used slogan "One Tree can Make a Million Matches—One Match can Destroy a Million Trees" is believed to have been originated by Mr. Wyman, the Secretary of this Association. Another popular slogan "Keep Michigan Green" was first used in 1928. The fact that Governor Green was running for reelection at the time was said to be purely coincidental.

Following 1911, extensive use was made of signs and posters by the

500 PEOPLE KILLED!

FIVE MILLION DOLLARS WORTH
OF PROPERTY BURNED BY

FOREST FIRES!

Lower Michigan and Ontario will never fully recover from the Fire Losses of July 1911. These FIRES DESTROYED LIVES and PROPERTY; BURNED HOMES and TOWNS; Caused FEAR and PANIC; Threw THOUSANDS of WORKMEN out of WAGES and out of FOOD; Created POVERTY and DISTRESS everywhere. What caused these fires?

Carelessness! MARK THE WORD! Carelessness!

CARELESSNESS IS RESPONSIBLE FOR FULLY 90 PER CENT OF ALL FOREST FIRES AND FOREST FIRE LOSSES. When CARELESSNESS becomes general it often results in DEATH. Who, then, is responsible? Would you like to feel that a fire STARTED by YOU or NEGLECTED by YOU had made a clean sweep of lives and property? Would you fire your friend's house knowing that his children were within? We are but children--often--helpless in the path of a raging forest fire.

What Can You Do? BE CAREFUL!

What Else? PUT YOUR CAMP FIRE OUT!

What Else? HOLD THAT MATCH UNTIL IT IS OUT!

What Else? LOOK FORWARD TO WHAT MIGHT HAPPEN!

If the property is NOT yours, PLAY FAIR! BE FAIR!

If the property IS yours, PLAY SAFE! BE SAFE!

THE TIME TO PUT THE FIRE OUT IS WHILE YOU CAN!

THE PREVENTION OF FOREST FIRES IS EVERY MAN'S DUTY.

For help, in case of fire, call upon the wardens of the

Northern Forest Protective Association

MUNISING, -:- MICHIGAN

Figure 3—Early fire warning poster.

State in its campaign to make the public forest fire conscious. The old cloth and paper fire signs nailed to trees and telephone poles were soon replaced by substantially constructed and artistically designed wooden signs located at strategic points along roads and highways.* Today the radio has largely replaced roadside signs as a means of reaching the public.

Conservation education began in 1915 with the employment of a lecturer to work with schools and other groups. This led to the establishment of an Educational Bureau in 1915 which the following year sponsored a wildlife exhibit at Saginaw, visited by some 60,000 people.

In 1916 a Forest Fire Congress was sponsored to which railroad officials and timber operators were especially invited. This meeting, held in Lansing March 13 and 14, was well attended and notable for the interest shown. Special consideration was given to ways and means of preventing railway and logging fires, the danger of which was generally recognized. There was considerable difference of opinion, however, as to measures called for and how far the railroads and timber operators could reasonably be expected to go in putting them into effect.

About 1921 the Department began to use motion pictures in its educational work and by 1924 had acquired 16 films totaling 18,000 feet and valued at \$5,744. These proved to be very popular with the public. In 1926, a forest fire film, "The Red Poacher," was shown at a number of theaters throughout the state. The following year a film library was established to meet the growing demand for public showings. While now many of the films deal with phases of conservation other than fire control, all serve to stimulate public interest in the conservation of the state's natural resources.

The success of educational efforts was so apparent that in 1929 a Division of Education and Public Relations was created to correlate the motion picture program, the weekly news service, exhibits, and various other related activities. It was also given the administration of the State's first advertising appropriation.

The same year the new division was formed, a film loan service was instituted through which conservation films were made available to clubs, schools, and other groups for the cost of transportation. During the first operating period this service reached some 360,153 people and some idea of its widening popularity can be deduced from the fact that in the 12-month period from September 1948 to September 1949, 3,366 loans were made and the films were shown to an audience numbering close to two million persons. A branch film loan library is operated in the Upper Peninsula.

The first conservation film with sound, "Nature's Gangsters," was shown in a majority of the theaters of the state in 1933. The same year an agreement was made with Metropolitan Pictures of Detroit to include conservation pictures in its news reels.

At the same time that motion pictures were being used with such good results, educational activities were being developed along other lines. A weekly news bulletin was started in 1927 and mailed to 498 daily and weekly newspapers. These news releases are still sent to more than 500 newspapers in Michigan and adjoining states. As a medium for the vast amount of constructive and entertaining con-

servation material over and above that which could be published in the news bulletin, a monthly magazine was started in 1931 with a mailing list of 2,500. Within a year the demand from schools, sportsmen's groups, clubs, and others jumped this to approximately 6,500. In the spring of 1935 this publication, "Michigan Conservation," was enlarged and placed on a subscription basis. At the beginning of 1949 the format was again changed and the magazine became a bi-monthly publication with an increased number of pages and a more attractive appearance.

From the limited start made in 1915, when one photographer-lecturer appeared infrequently before small gatherings in scattered parts of the state, the lecture service of the Division has been built up so that from September 1948 through August 1949, 211 lectures were given before a total audience of 22,436. In addition, Division personnel participated in radio programs and gave many informal talks, not technically classed as lectures, in schoolrooms and organization meetings.

The staging of exhibits, now discontinued, throughout the state at sportsmen's meetings, fairs, outdoor shows and other gatherings was an important phase in the development of conservation education activities. In 1935 and 1936 two portable exhibits were created. One was an elaborate display built into the Department's railroad car "Wolverine" which visited 38 cities and villages in the Upper Peninsula and northern part of the Lower Peninsula, traveling 1,318 miles in the fall of 1935. The other was a trailer-transported exhibit, 20 x 60 feet in size when erected.

Staff members of the Education Division act as consultants for teachers and women's organizations to incorporate conservation in schoolroom subjects and club programs. By means of workshops, field trips and other training sessions these representatives train teachers and promote interest in conservation education.

Pioneer work has been done in Michigan by the Department of Conservation in cooperation with the Department of Public Instruction in the school camping program, the purpose of which is to get boys and girls into the outdoors as part of their school work. Experimental camps have been held and it is hoped that eventually the program can be expanded to include annually as many as 150,000 pupils in junior and senior high schools of the state.

The Education Division operates the Department Training School at Higgins Lake. The main purpose of the school is to give in-service training to Department employees. Since 1936, conservation officers have been given a training and indoctrination course in the policies, methods, and technique of forest fire prevention and control, law enforcement and all phases of conservation. This program has aided materially in developing the competence and efficiency of Department personnel and has helped in the progress made in the handling of conservation activities. In addition to the School's in-service training program, it is playing a vital part in training teachers in conservation and promoting general conservation education among groups that are in other fields of work but are interested in conservation.



Figure 4-A—Old open platform, windmill-type lookout tower.

Forest Fire Detection

With no towers and few telephones available it is easy to see why the early fire wardens were able to accomplish so little in the way of forest fire suppression. Locating fires by patrol was like looking for a needle in a hay stack and only by accident were they discovered while small enough to handle. Patrol, however, had one advantage: It brought the fire wardens in contact with the public and enabled them to spread the gospel of fire control.

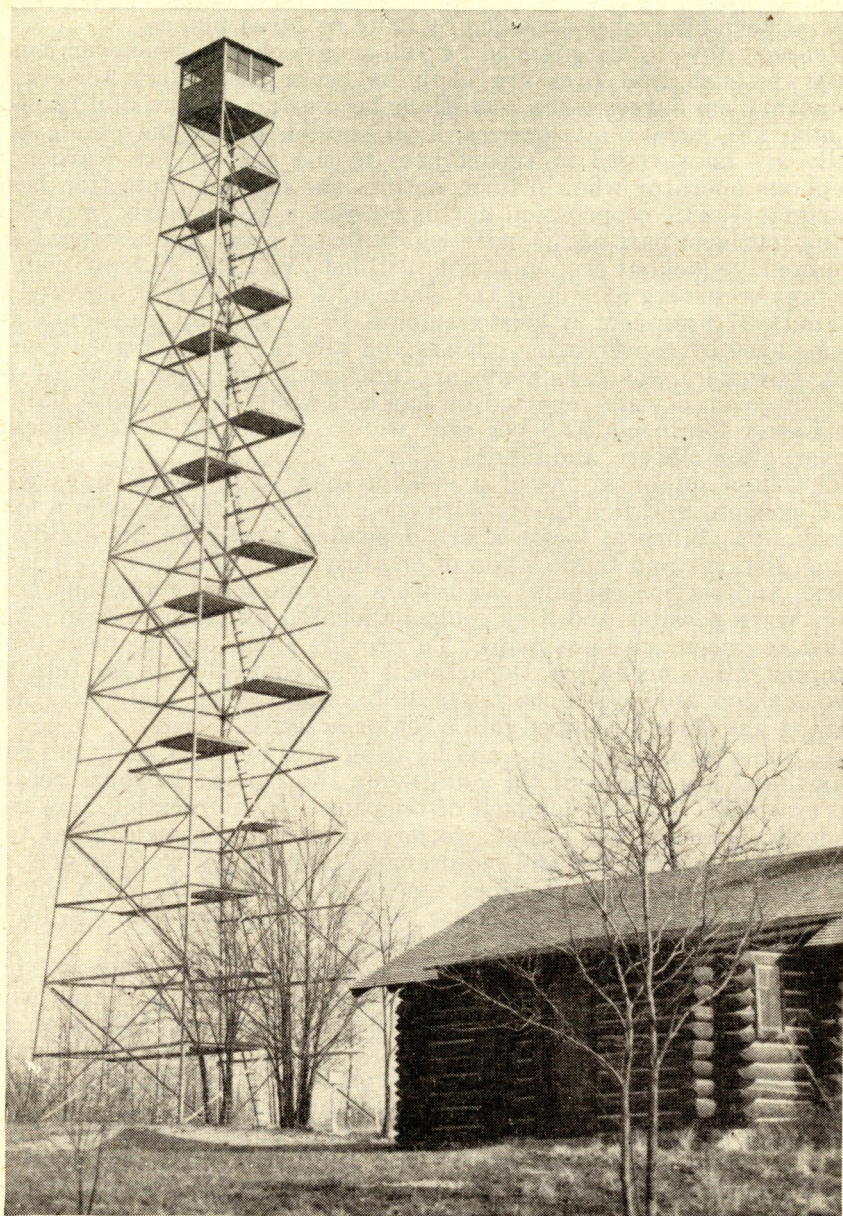
The first lookouts were trees or high points used by the patrolmen to obtain a wider view of the country. A tall tree near Racó was long used for this purpose. Fitted with spikes to make climbing easier it became a local landmark and remained in use until removed when the highway was improved. The use of such vantage points led to the erection of small windmill type towers with open platforms at high points along patrol routes. It was soon found, however, that a man stationed in a well located tower could see more country than a patrolman could cover in a day's travel, with the added advantage of having it under constant observation. The result was the early substitution of lookouts for patrol.

The first lookout tower in Michigan was a low wooden affair built by the Northern Hardwood Manufacturers Association on a hill in the vicinity of Lewiston about 1912 (Figure 4). The first steel tower was erected by the State on the Houghton Lake State Forest in 1913. In 1915, the second steel tower was erected on the Hanson Game Refuge near Grayling. The following year three towers were ordered for the Upper Peninsula and each year thereafter more were added until by 1924, 106 towers were in use and their coordination was recommended to avoid overlapping and to fill in gaps.

About this time towers with enclosed cabins began to be used in place of the old open platform type and stairways began to replace ladders. By 1928 the tower system was considered practically complete and most of the primary towers were of the enclosed cabin type. The score at that time stood: cabin type primary towers, 107; open platform secondary towers, 16. In addition, 19 open platform towers were in use on the State Forests and Game Refuges. In 1949, the State had 140 primary towers and five secondary towers in operation.

The standard lookout tower today is a specially designed 100- to 150-foot steel tower with a glass enclosed eight-foot square platform reached by a substantially built inside stairway. Wherever possible towers are erected on high points to increase their range of vision. The average effective range of such towers is about 10 miles when the air is clear, but may be more or less than 10 miles in some directions depending on the topography. To make possible the location of fires by cross shots, towers are located so that their fields of vision overlap, roughly at 15-mile intervals. This is varied, however, as need and topography demand, the aim being to secure as full coverage as practicable, particularly where risk and hazard are high.

Each lookout is equipped with a detailed map of the area covered, an alidade for accurately determining the direction from the tower of any fires discovered and a telephone or radio, or both, by which fires can be reported to the nearest fire headquarters or conservation officer.



4-B—Modern enclosed cabin tower with stairway.

As a rule, nearby fires are located by their position in relation to local landmarks, fires at a distance by cross shots from adjoining towers. When visibility is poor secondary towers are manned and in emergencies aerial patrol is provided by state or hired planes.

Primary towers are manned by full-time lookouts whenever conditions are such that fires are likely to occur; secondary towers by temporary employees when conditions become acute or visibility poor. In addition, rural mail carriers, local residents, and the public generally are encouraged to report fires to the nearest fire warden or telephone operator who, in turn, notifies the nearest protection headquarters. Public cooperation in this respect is particularly important in the southern part of the state where forest areas are scattered and an intensive lookout system is not justified. In 1948, 38.9 per cent of the fires occurring outside of the National Forests were discovered by lookouts, 27.4 per cent by local residents, 10 per cent by transients, and the balance by conservation officers and others. In the Upper Peninsula, however, where lookouts are numerous, 56.1 per cent of the fires discovered were reported by lookouts while in the south half of the Lower Peninsula 92.8 per cent were reported by local residents, conservation officers, and others.

The chief qualifications of a lookout man in the early days were good eyesight and familiarity with the country. Lacking even a map, a lookout's ability to locate a fire depended wholly on his ability to judge distance and the location of the fire in relation to known landmarks and section corners. As towers became more numerous cross shots were possible and fires could be located by triangulation. This called for accurate base maps. To provide these and to meet other administrative needs the Department was compelled to go into the map making business since few suitable maps were available. Map making has since developed into a major activity.

As maps became available and locating fires by cross shots the rule, a firsthand knowledge of the country on the part of lookouts became less essential. The development of telephone communication, however, made it necessary for lookouts to have a working knowledge of telephone-line construction and maintenance, since they were largely depended on to maintain the lines serving these stations. With the advent of the radio, the lookout's job became even more technical for he now had to qualify as a radio operator.

Having discovered a fire, the early lookouts had also to fight it since they had no means of reporting it or summoning help. Later when telephones were available, they served as dispatchers calling on the nearest local warden or keyman to take action. Today they function chiefly as the eyes of the District Dispatcher, notifying him when a fire is discovered and keeping him informed as to its behavior. Not only must they have good eyesight and be familiar with the country, but they must be able to operate their radio, make meteorological observations, distinguish between unauthorized and legitimate smokes, judge the character and probable behavior of fires discovered, and be constantly on the alert whenever fires are likely to occur. It helps also if lookouts are good public relations men for accessible towers are frequently visited, and contact with visitors offers an excellent opportunity to promote fire prevention.

Communication

The swing to lookouts from patrol for fire detection made the need for telephones acute, since a lookout that could not report a fire when it was discovered or summon help promptly was of little use. Commercial telephone facilities were meager or lacking in the area where fire control was most needed, so the State was forced to undertake an extensive program of telephone-line construction. Where possible, connections were made with local lines, but many miles of line had to be constructed to reach towers and fire wardens where commercial lines were not available.

The first lines constructed were crude single wire ground lines often attached to trees or locally cut poles. These were not too satisfactory and were soon replaced with two wire pole lines of standard construction. Wire for the first line was ordered in 1916. By 1933 the State owned and operated about 1,000 miles of metallic circuit.

In 1933 the Department realized that radio might be the solution of its communication problem and two radio engineers were employed to conduct experiments and determine the type of equipment best suited to fire control needs. A number of two-way, medium-low frequency sets were obtained through the U. S. Forest Service and put to use in the field on an experimental basis. A radio laboratory was also set up at Roscommon. As a result, a low-power two-way battery operated radio set was designed and proved practical for inter-tower communication and for contact with portable field sets on going fires. During 1938, 1939, and 1940, approximately 120 of these battery operated sets were constructed by the Department and installed in fire towers. Two-way fixed station remote-control radio units were also installed in each protection district to provide direct radio contact between the towers and district headquarters. Experiments were also carried on with portable back pack type radio sets. By the time this unit was perfected, however, the war emergency made it impossible to purchase the necessary parts and equipment, and the project had to be dropped.

After the Pearl Harbor disaster, December 7, 1941, the Legislature provided funds for fixed station and mobile, two-way FM radio equipment to better cope with possible sabotage and subversive activities by tying the conservation radio network in with that of the State Police. As a result each district headquarters was equipped with two-way FM radio on 37,380-37,500 kilocycles which made direct contact with the state's 132 radio-equipped police cars possible. Each district headquarters north of Grand Rapids was also furnished with AM radio equipment operating on 35,740 kilocycles to provide two-way communication with towers and AM equipped mobile units operating out of the district headquarters. The two systems were necessary since the 35,740 AM channel was restricted to fire control business.

Experiments with plane to ground radio communication were started at Lansing in 1934 in cooperation with the Michigan State Board of Aeronautics which furnished a plane and pilot. The first radio equipment tried had a wave length of 60,000 kilocycles (five meters). From the start it was more successful than had been anticipated. In the summer of 1934, the original test equipment was trans-

ferred to Mio where an experimental link of seven miles was established between Mio district headquarters and the Mt. Tom fire tower. Forest fires in October necessitated the use of a state plane for observation and for three days successful contacts were made by radio between the plane and this tower, messages being relayed to district headquarters by plane. On its return trip to Lansing, communications between the plane and Mt. Tom tower were maintained to a distance of 100 miles.

During 1935 and 1936 two state planes were equipped with low-frequency radio installations (3,445 kilocycles) which made communication between the planes and protection headquarters possible in fire emergencies. This proved extremely useful in a number of cases. When the Department changed to high frequency in 1938, the low-frequency plane sets were replaced by a high-frequency unit in one of the planes.

Since the war the radio system has been expanded to include the southern part of the state; five 300-foot, one 200-foot, and five 135-foot towers have been constructed; all lookouts have been equipped with two-way radios; and 250 portable FM sets have been installed in conservation officers' cars and fire trucks. The radio system now (1949) includes 20 FM 250-watt fixed stations, 250 FM 50-watt mobile units, 2 FM 10-watt airplane units, 14 AM 20- to 50-watt fixed stations, 20 AM 20-watt mobile units, and 120 AM two-watt tower units. To maintain this system a staff of 13, including a communications supervisor and 10 radio engineers, is employed.

Under a recent ruling of the Federal Communications Commission two new channels have been made available to the state and the regulations broadened to permit conservation as well as forestry business to be transacted. In the future, the Department's fire business will be conducted on 46.66 Mc and its game law enforcement and miscellaneous business on 46.58 Mc. This will relieve the overload on the channel used by the State Police and should result in more satisfactory service for both agencies. It is planned also to replace the present obsolete AM system with modern FM units as soon as funds are available. The new radio set-up will cover the entire state; provide direct contact between Lansing and district headquarters, and between district headquarters, towers, and mobile units, within their power range.

Equipment Development

While the principles of fire control remain the same there has been a vast change in equipment and techniques used in fighting forest fires since organized fire control got under way. The standard equipment of the pioneer fire warden was a round pointed shovel, a pail, and a pocket full of matches. Each fire fighter furnished his own tools. Small fires were put out by scratching a line around them and covering burning logs and stumps with dirt or perhaps wetting them down with water from a nearby stream. Backfiring from roads or natural barriers was the usual procedure on large fires. The first state-owned equipment consisted of 18 long-handled shovels purchased to equip fire fighters on a large fire about 1912. This purchase was questioned by the Auditor General and it was six months or more

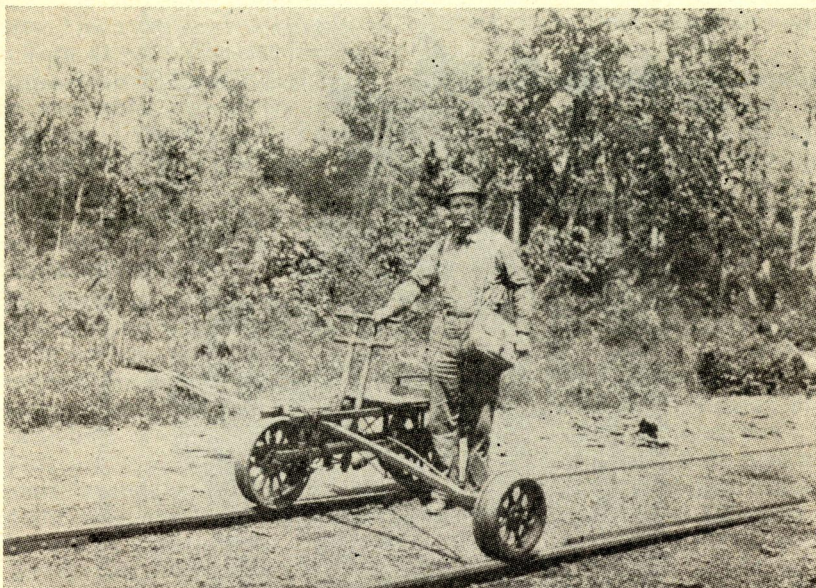


Figure 5—A Michigan forest fire speeder-patrolman, 1916.

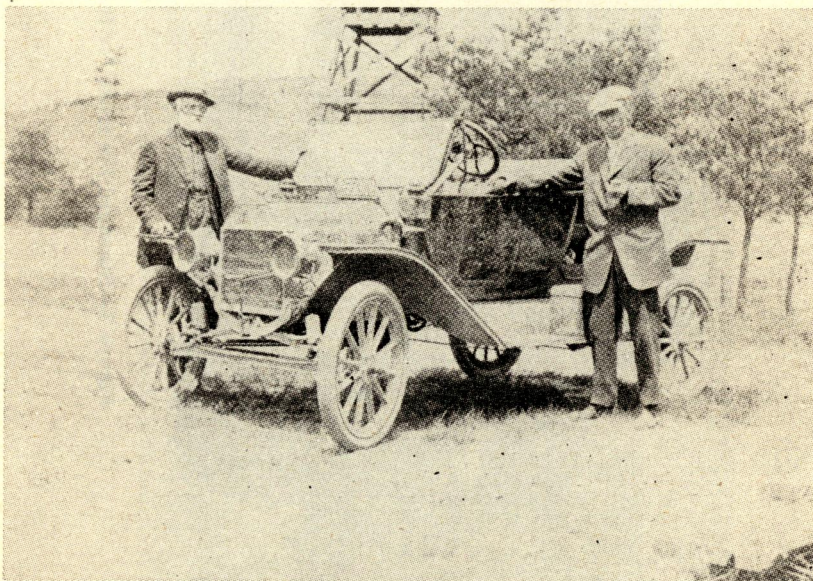


Figure 6—A "flying squadron"—1916.

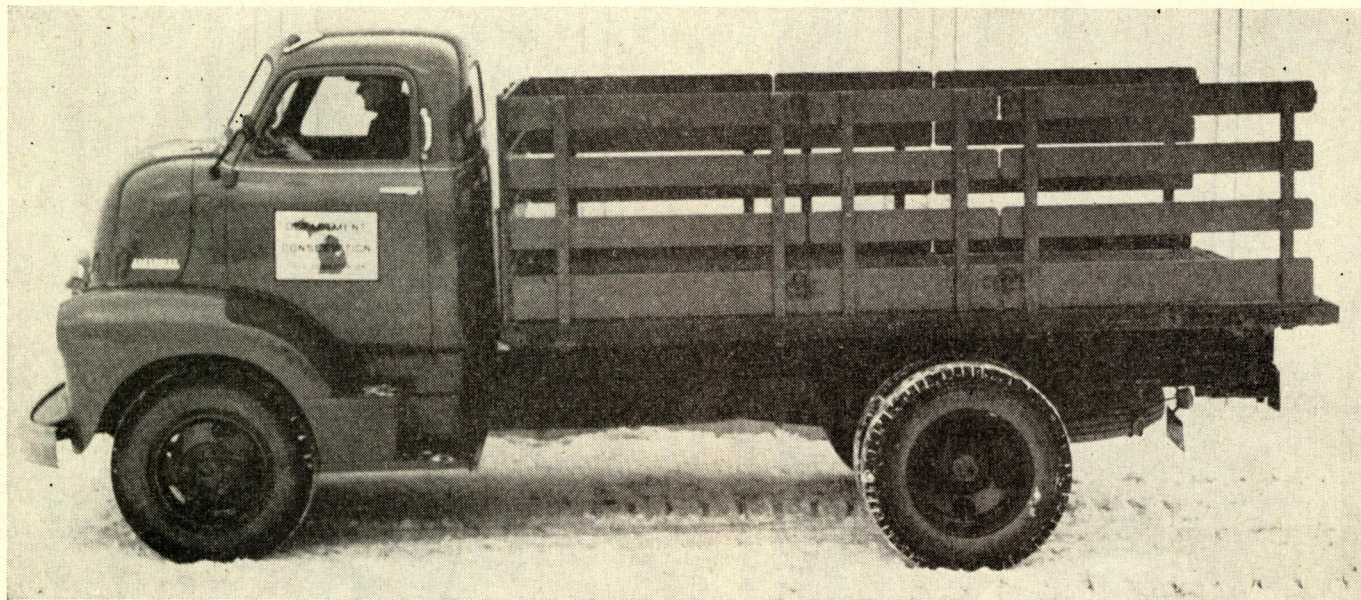


Figure 7—Standard fire truck for transportation of men and equipment, Michigan, 1948.

before the bill was paid. Furnishing tools for fire fighters later became the rule, and a supply of shovels, axes, and saws has since been kept at each district headquarters for this purpose.

Horse-drawn plows, hired from local farmers, were used occasionally when available, but plows did not become standard equipment until the advent of the tractor. Very little use was made of water, although one old-time fire warden recalls carrying around a garden sprinkler to wet down grass fires ahead of the shovelmens. With the development of the back pack pump about 1920, the use of water became general and led eventually to the use of power pumps and tankers, particularly for mop-up work on peat and slash fires.

The State purchased its first tractor in 1917 for use in fire line construction on the Higgins Lake State Forest. Not until some years later, however, was power equipment provided for fire suppression. Its extensive use dates from Civilian Conservation Corps days.

Transportation has always been a major problem. The early state fire wardens traveled on foot or by horse and buggy and were dependent on local help for fire suppression. Hand and foot operated railroad "speeders" or velocipedes were also used in patrolling railroad rights-of-way and reaching otherwise inaccessible areas (Figure 5).

The use of automobiles dates from about 1915. In its annual report for 1916, the Public Domain Commission points with pride to its "flying squadrons," two or more fire wardens with a Model T Ford, organized to take action on major fires. (Figure 6.) In 1917 automobiles were purchased for use on the State Forests. Fire wardens, however, continued to furnish their own transportation and haul fire fighters on a mileage basis. In 1928 the Conservation Commission

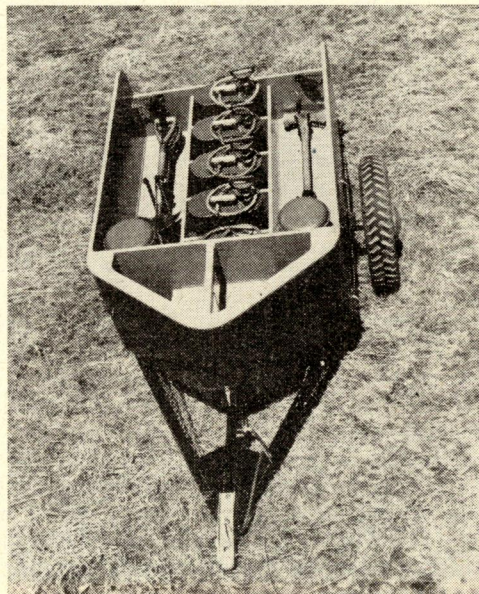


Figure 8—Standard trailer with fire-fighting equipment, Michigan.

authorized the purchase of 12 trucks for fire control work, chiefly for the hauling of fire fighters, supplies, and tools (Figure 7).

About this time, also, light trailers were provided for hauling supplies and equipment, and all forest officers' cars were fitted with trailer hitches (Figure 8). Trucks and trailers are now standard equipment. At present the trend is toward the use of four-wheel drive trucks because of their better traction and adaptability to off-the-road use.

Horse-drawn plows early demonstrated their usefulness for fire line construction but were handicapped by lack of power for tough going. The use of tractors overcame the power difficulty but made heavier and sturdier plows necessary (Figure 9).

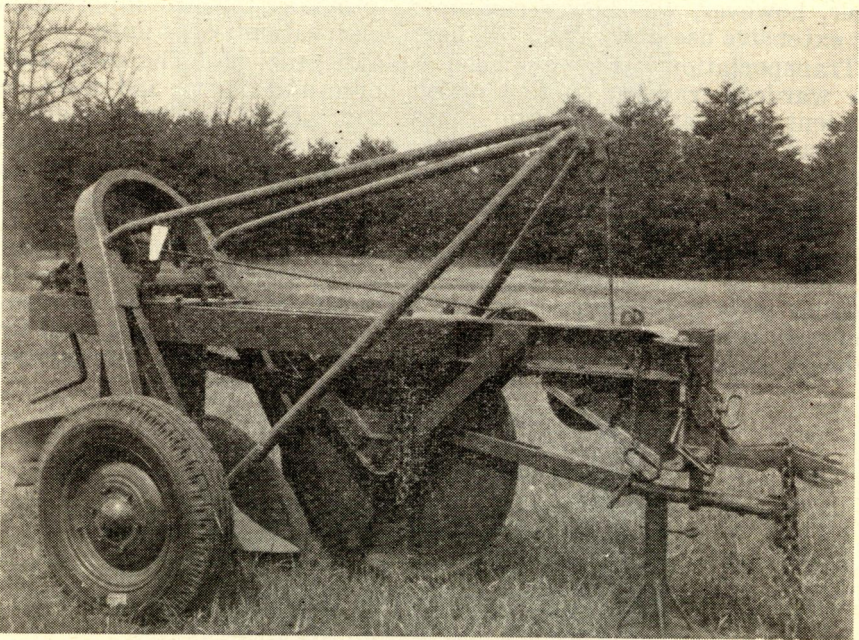


Figure 9—Michigan heavy duty tractor plow.

This made transportation a problem. The answer in Michigan was the development of a rubber-tired sulky plow with a trailer hitch that can be hauled to fires on its own wheels at road speeds by a car or truck. Starting with an ordinary single moldboard breaking plow, various types of plows were tried out. For general all round use a 36-inch double moldboard plow with a 33-inch rolling coultter and sod cutters proved to be most satisfactory. (Figure 10.) For ordinary going a lighter plow of similar design attached direct to a tractor with a hydraulic lift has recently been developed. This plow promises to be even more useful than the heavier unit because of its greater mobility and ease of handling.

In the days of hand tools, building a fire line through slash and

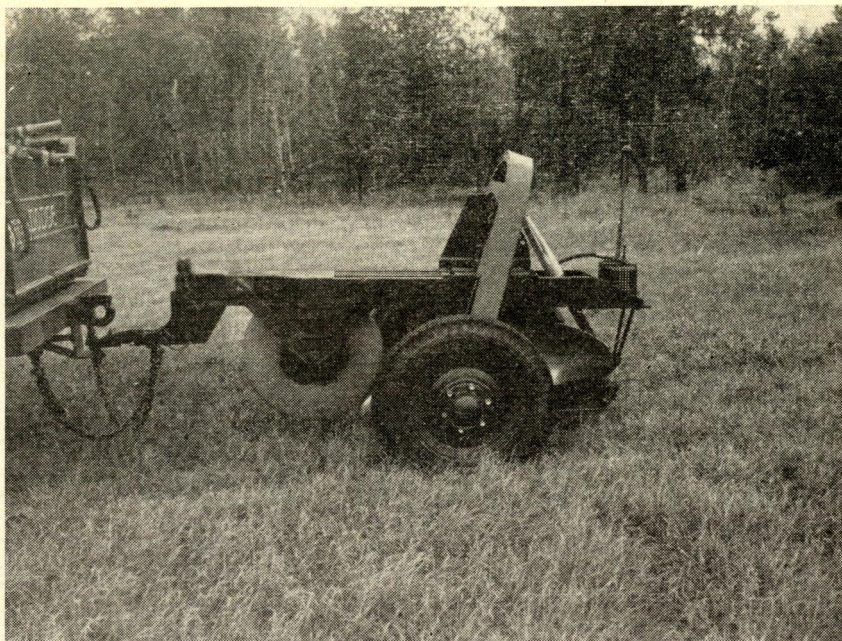


Figure 10—Michigan standard double moldboard sulky plow.



Figure 11—Bulldozer clearing a fire line through slash or heavy second growth.



Figure 12—Michigan well-sinking outfit in operation.

heavy brush or second growth was a laborious and time-consuming operation. Today bulldozers clear a line in short order. (Figure 11).

The use of water in fighting forest fires has always been limited by its availability. It is, however, a most effective agent and its use was stimulated by the discovery that even small quantities were effective if properly applied. This resulted in the development of the back pack pump and its wide use on fires, particularly in light fuels, grass, pine needles, leaves, etc. To keep back pack pumps in operation, however, called for a supply of water on the fire line. This led to the general use of 10-gallon milk cans hauled in by truck and distributed at convenient intervals along the fire line, and to the use of tankers. In many cases, however, water still had to be hauled long distances.

About 1930 it was discovered that in many places ground water was available near the surface and could be readily obtained by means of shallow driven wells. The first use made of this fact was to provide water for camp use. Later such wells were used to refill back pack pump cans. But hand pumping was slow; so shallow well pumps powered by light gas engines began to be used. To expedite the sinking of wells, an outfit was developed about 1933 by Gilbert I. Stewart of the Michigan Forest Fire Experiment Station, which made it possible to sink wells to a depth of 20 feet in as little as five minutes by means of water under pressure provided by a power tanker (Figure 12).

Where ground water is available and conditions for sinking wells



Figure 13—A Michigan trailer-mounted heavy duty power pump, operating from a washed-in well.

by this method are favorable, sufficient water can be developed to operate a power pump either for direct use on fires or to supply back pack pumps and tankers. The method has been used frequently on peat and slash fires where a large amount of water is required for mop-up work. (Figure 13).

Power pumps have been found to be of little use on running fires because of the time required to lay hose lines, and in many cases the absence of a readily available water supply. For mop-up work in heavy fuels, however, they have proved to be invaluable. Heavy duty low-speed pumps have been found best suited for this purpose because of their ability to stand up under continuous use over long periods with a minimum of attention. While heavy, they are readily transported by truck and mounted on skids, and can be hauled anywhere a tractor can go. But little use has been found for the light weight high-speed pumps extensively used in other regions.

On running fires, particularly in open country, tankers with power pumps have proved useful. This has led to equipping pick-ups and fire trucks with water tanks and takeoff power pumps and to the development of a booster unit consisting of a tank mounted on a trailer with a small gas-engine operated pump and 200 feet of garden hose mounted on a live reel. Pulled by a tractor or a four-wheel drive truck, this outfit has proved to be very effective on going fires in light fuels, where the economical use of water is necessary. (Figure 14).

A recent development for use on grass fires consists of a four-wheel drive tank truck equipped with a flame thrower for backfiring from a wet fire line laid down by adjustable spray nozzles attached to the rear of the truck. This outfit is believed to have great possibilities in open grass country where fires spread rapidly and prompt control is necessary to hold down the acreage burned.

The effectiveness of thrown dirt in knocking down fires and of fire lines in checking their spread early, suggested the possibility of combining these features in a line-building machine that would speed up fire line construction by eliminating the use of water and plows. Pioneer work in developing such an outfit was done by the U. S. Forest Service in the West. The Bosworth trencher was the result. Later a similar machine known as the Allegheny trencher was developed in Pennsylvania. Both of these machines were for use in rough country, hence lightness and portability were primary essentials in their design. In Michigan, where transportation is not so much of a problem, a heavier outfit with the advantage of greater power and effectiveness was considered advisable. This resulted in the experimental development of a line-building machine and dirt thrower based on the Gravelly walking tractor. As a light weight one-man outfit to fill the gap between a crew with hand tools and the heavy duty tractor-plow units, the outfit in question has distinct possibilities since in ordinary going it will build an adequate fire line as fast as 25 or 30 men with hand tools. A still sturdier model, however, was desired and is now being developed.

Also in the experimental stage are high pressure tankers and fog nozzles for smothering slash and crown fires. Some work, too, has been done with detergents and fire-retarding chemicals in an attempt

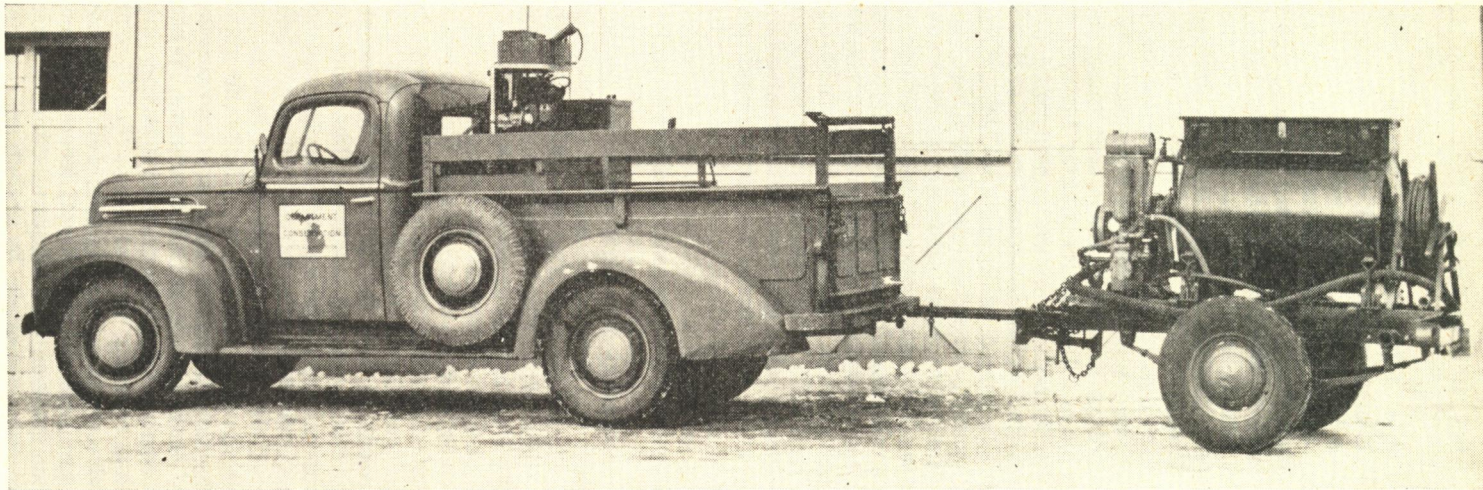


Figure 14—Michigan trailer-mounted booster unit.

to reduce the amount of water needed to control fires by increasing its effectiveness. While promising, the cost and practical difficulties involved still stand in the way of their general use.

The airplane first came into the picture in 1933 when a National Guard plane was flown from Detroit to Grayling for reconnaissance work on the Lovells fire. Because of the many fires burning at the time, visibility was down to one or two miles and the towers were of little use. Periodic flights around the fire helped materially in locating break-outs and spot fires. While lack of radio communication was a handicap the value of observation planes on large fires was clearly demonstrated and led to their further use. While planes are not used for fire detection in Michigan except in an emergency when visibility is low, they are called on frequently for reconnaissance work on large fires and with radio communication have proved to be extremely useful. Two state planes are now available when needed for this purpose, and it is planned to obtain another.

Since 1930 the Department of Conservation has operated a Forest Fire Experiment Station at Roscommon that has specialized in fire equipment testing and development. This Station has contributed materially to the standardization and development of forest fire equipment and is largely responsible for the progress that has been made in Michigan in this direction. With a modern, fully equipped pattern and machine shop, and a full-time staff of mechanics and technicians, it has been in a position to design, test, modify, and build pilot models of promising fire control equipment and to prepare specifications for their manufacture.

Railroad Fire Prevention and Control

Railroad operation was at one time the chief cause of forest fires in Michigan. Today, it rates third and is normally responsible for less than 10 per cent of the fires reported and three per cent of the area burned. Two things account for this improvement, hazard reduction and the adoption of safety measures.

The days of railroad development and expansion in Michigan were also the days of extensive land clearing and forest exploitation. From the beginning, railroad development and logging have been intimately connected. In fact, practically all of the railroads north of Lansing began as logging roads or were built to tap the rich stands of virgin timber then thought to be inexhaustible. The vast amount of slash resulting from right-of-way clearing and logging operations, together with the lack of any effective measures to prevent fires starting, set the stage for many of the disastrous fires that have occurred and made railroad operation extremely hazardous. To make matters worse, the first locomotives burned wood for fuel and showered passengers as well as the right-of-way with sparks and embers. When coal replaced wood as fuel, fires occurred less frequently but the railroad fire problem was by no means solved.

The use of spark arresters was considered seriously early in the development of steam locomotives. First, screens or hoods were placed over the stack, then balloon and diamond stacks were invented. In 1883, the first attempt was made to arrest sparks in the front end

or smoke box of the locomotive. This led to the development of the Master Mechanic and Mudge-Slater spark arresters which have since become standard equipment. While generally effective if properly installed and maintained, the front-end screen type spark arrester requires frequent inspection and is not satisfactory with poor grades of coal. Its general use, however, has greatly reduced the number of fires started by locomotives. A later development is the Cyclone type of spark arrester which does away with the use of screens and is more efficient. Its maintenance is more expensive, however, and it has not been used extensively.

Sparks from the stack are not the only source of locomotive fires. Live coals, clinkers, and hot ashes falling from ash pans or deposited on the right-of-way were early found to be equally responsible. Better designed ash pans, frequent inspections and regulations prohibiting the dumping of ashes where they can start fires have done much to eliminate fires from this source. The use of oil for fuel, however, appears to be the solution of the locomotive fire problem.

Active interest of Michigan railroads in forest fire prevention and control dates from 1873 when they were made legally responsible for fires set by their locomotives. This resulted in frequent damage suits and paved the way for the adoption of safety measures. Not until 1903, however, were railroads required to use spark arresters and clean up their rights-of-way, and not until a locomotive inspector was appointed in 1912 to work with the railroads, was any serious attempt made to prevent railroad fires.

In general, the railroads have cooperated with the state locomotive inspectors and shown a commendable willingness to adopt measures suggested for the prevention and control of railroad fires. This has involved cleaning up rights-of-way, installation and maintenance of approved spark arresters and ash pans, regulations as to where ashes may be dumped, posting of fire warnings in trains and stations, reporting fires discovered by train crews, patrolling behind trains on high danger days, and cooperating with the state and federal fire wardens in suppressing fires that occur along rights-of-way. Recently, also, they have gone so far as to plow fire lines on the outside edge of their rights-of-way and burn off the rights-of-way in particularly hazardous areas. Approximately 1,000 miles of fire lines have been constructed and are being maintained by the railroad companies in Michigan. The over-all result of this effort has been to greatly reduce the railroad fire hazard as the record shows. Unfortunately a serious set back occurred in 1946 and 1947 when, because of the national fuel shortage, the railroads had to use inferior grades of coal. This resulted in an upsurge in the number of railroad fires. Every effort was made, however, to remedy the situation when the trouble was located, even to reshipping poor coal to less hazardous areas. With the danger recognized and better coal available, no further trouble from this source is anticipated, and with the continued cooperation of the railroads, railroad fires should again become a minor source of trouble.

At the present time Michigan has three locomotive inspectors, one each in the Upper and Lower Peninsulas, and a chief inspector who is attached to the Lansing office and who supervises the work and maintains contacts with the officials of railroads operating in the state.

Rights-of-way are inspected annually, and locomotives at periodical intervals. Special inspection of locomotives is also made when reports are received of their setting fires. Special reports on all railroad fires are made to the State Locomotive Inspector and the railroad company responsible, and the localities where railroad fires are most frequent are given special attention.

The policy of the State in dealing with the railroads has been one of cooperation rather than coercion. This has resulted in friendly relations and a willingness on the part of the railroads to go considerably beyond the letter of the law in the matter of fire prevention.

MICHIGAN'S PRESENT FOREST FIRE PROBLEM

Area in Need of Protection

Approximately 25 million acres (24,705,218), or 68 per cent of Michigan's total land area (36,494,080 acres), is in need of protection from fire. The bulk of this land lies in the Upper Peninsula and in the northern half of the Lower Peninsula (Figure 16). The balance is scattered throughout the southern counties as farm woods and more or less isolated tracts of wild land. While the major part of the fire control problem obviously lies in the northern counties where forest land predominates and where large fires are most likely to occur, the harm done by fires in the woodland area cannot be overlooked.

Of the area in need of protection, about 18 per cent or four and a half million acres is owned by the State, 11 per cent or two and a half million acres by the Federal Government, and 71 per cent by private individuals, corporations and local public agencies. Responsibility for fire control, however, is assumed by the State and Federal governments, the latter protecting the land within National Forest and Park boundaries, while the State protects the land outside. Under this arrangement the State is responsible for protecting some 20,300,000 acres, or 82 per cent of the total. (Table 3).

Organization of State Protection Effort

Outside of the National Forests and Isle Royale National Park, forest fire control, together with various other conservation activities, is the direct responsibility of the Michigan Department of Conservation. (See Organization Chart, Figure 17.) At the head of the department is a director, appointed by and responsible to a nonsalaried seven-man conservation commission, the members of which are appointed by the Governor for overlapping six-year terms.

Within the Department of Conservation fire control, as well as conservation law enforcement, is the responsibility of the Division of Field Administration.

For administrative purposes the state is divided into three regions (upper Michigan, northern lower Michigan, and southern lower Michigan) with headquarters at Marquette, Roscommon, and Jackson, respectively. In charge of each region is a regional chief assisted by a staff of specialists representing the various divisions of the depart-

Table 3.—Ownership of land in need of protection and area protected by state and federal agencies—Michigan

Ownership class	Area in need of protection
	Acres
State	
Forest.....	2,020,972
Game areas.....	1,301,776
Deeryards.....	109,792
Parks.....	109,850
Administrative, etc.....	26,341
Other.....	893,303
Total.....	4,462,034
Federal	
National forests.....	2,353,406
National parks.....	133,839
Wildlife areas.....	93,835
Indian lands.....	17,626
Other.....	42,010
Total.....	2,640,716
County and municipal.....	77,000
Private.....	17,525,468
Total all ownership classes.....	24,705,218
	Acres
Area protected by:	
Michigan Department of Conservation.....	20,301,549
U. S. Forest Service.....	4,269,830
National Park Service.....	133,839

ment. The regions, in turn, are divided into conservation districts, each with a district supervisor in charge.

Under the district supervisors are some 164 conservation officers locally responsible for both forest fire control and conservation law enforcement. Supplementing their efforts are 90 full-time fire officers and various seasonal employees, lookouts, equipment operators, local fire wardens, keymen, etc. Fire fighters are hired locally as needed by the conservation and fire officers in whose territory the fire occurs.

When a fire is reported, the nearest conservation or fire officer is notified and takes necessary action. In the case of large fires, the district supervisor may take over, mobilizing the resources of the district, and calling on the regional chief for additional personnel and equipment from other districts if needed.

At present (1949) Michigan is divided into 12 state protection units (conservation districts), ranging in size from 1,093,110 to 2,380,620 acres exclusive of land not in need of protection. In addition there are six federal units administered by the National Forest and Park Services (Figure 18 and Table 4).

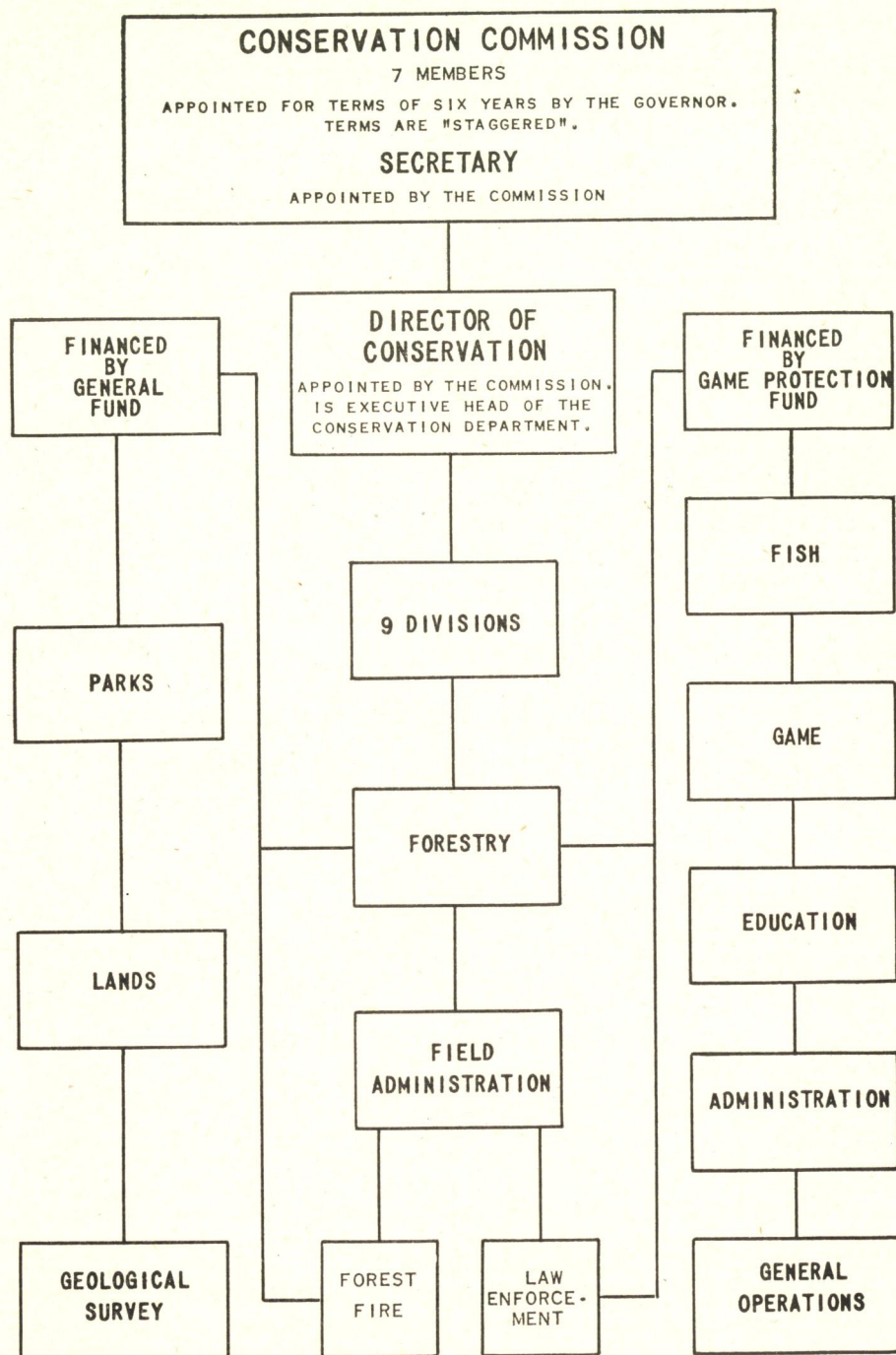


Figure 16—Organization of the Michigan Department of Conservation.

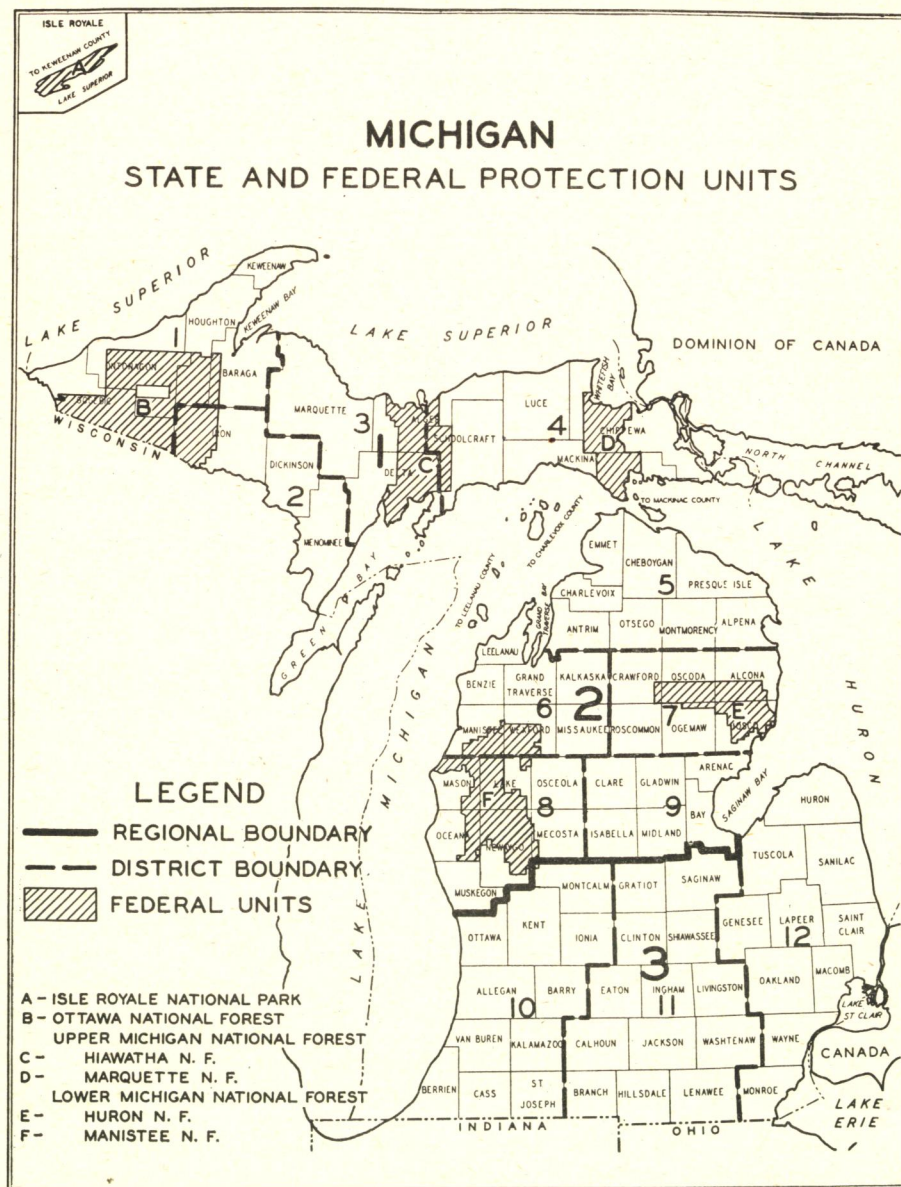


Figure 17—State and federal protection units, Michigan.

Table 4.—State and federal protection units, Michigan—1949

Protection unit	Gross land area ¹	Area protected ²
	Acres	Acres
State		
Region I		
District 1.....	1,957,487	1,795,979
2.....	1,643,509	1,480,062
3.....	1,761,856	1,628,683
4.....	2,558,514	2,364,495
Total Region I.....	7,921,366	7,269,219
Region II		
District 5.....	2,805,760	2,380,620
6.....	1,847,799	1,376,614
7.....	1,604,867	1,414,129
8.....	1,803,099	1,093,110
9.....	1,907,840	1,212,231
Total Region II.....	9,969,365	7,476,704
Region III		
District 10.....	4,378,240	1,858,379
11.....	5,233,280	2,027,114
12.....	4,588,160	1,670,133
Total Region III.....	14,199,680	5,555,626
Total State.....	32,090,411	20,301,549
FEDERAL ³		
Ottawa National Forest.....	1,742,966	1,319,245
Upper Michigan National Forest		
Hiawatha Unit.....	822,013	706,453
Marquette Unit.....	503,417	503,417
Total Upper Michigan.....	3,068,396	1,209,870
Lower Michigan National Forest		
Huron Unit.....	762,311	601,213
Manistee Unit.....	1,254,855	1,139,502
Total Lower Michigan.....	2,017,166	1,740,715
Isle Royale National Park.....	133,839	133,839
Total federal.....	5,219,401	4,403,669
Total for state and federal.....	37,309,812	24,705,218

¹Based on 1945 Agricultural Census—U. S. Dept. of Commerce.²Total land area less cropland, area of towns and cities of 1,000 or over population, and area protected by federal agencies.³Federal protection units, based on gross area protected.

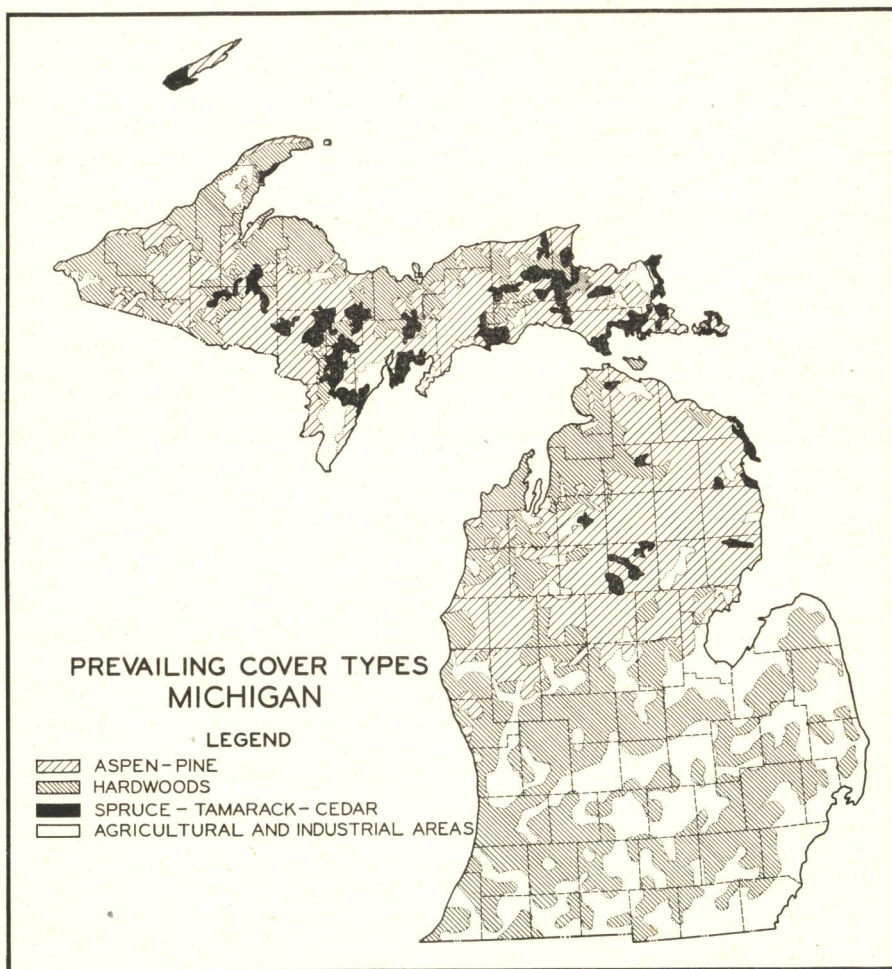


Figure 18—Prevailing cover types, Michigan.

Character of Land Protected

According to the latest forest inventory (1945) 19 million acres, or about 76 per cent of the 25 million acres in need of protection, is forest or potential forest land. The remainder consists of bog and marsh, unimproved farm land, rights-of-way, and other areas subject to forest fires.

In northern Michigan the forest consists primarily of second growth and reproduction that has come in since the original stand was cut. Less than a million acres of virgin timber, chiefly hardwood, remain. The woodland areas in the southern part of the state are for the most part culled and overgrazed remnants of the original forest. While wild land in general is now restocking, the effect of past forest fires is reflected in the preponderance of younger age classes, mostly dating

from the inception of fire control; in understocking; and in the prevalence of less desirable species, such as aspen, scrub oak, and jack pine. (Figure 19 and Table 5.)

Table 5.—Character and condition of Michigan's forest land¹

Kind of forest land	Forest land area
	Acres
Total forest land area.....	19,000,000
Area classified as to use	
Commercial forest land.....	17,380,000
Farm woodland.....	3,814,000
Other.....	13,566,000
Noncommercial forest land ²	1,620,000
Area by forest type	
Pine.....	1,653,000
Spruce-fir.....	1,634,000
Swamp.....	2,888,000
Oak and oak-hickory.....	988,000
Northern hardwoods.....	5,396,000
Aspen-birch.....	6,441,000
Area by size classes	
Saw timber ³	2,943,000
Pole timber ⁴	4,043,000
Seedlings and saplings ⁵	7,430,000
Poorly stocked and denuded.....	4,584,000

¹Based on forest-survey data compiled by the Lake States Forest Experiment Station.

²Parks, recreational areas, and forest land chiefly valuable for other than timber production.

³Land with at least 2,000 board feet of merchantable timber per acre, mostly in trees over nine inches, d.b.h.

⁴Land with from three cords to 2,000 board feet of merchantable timber per acre, mostly in trees from five to nine inches d.b.h.

⁵At least 40 per cent stocked, trees mostly under five inches d.b.h.

Relative Risk of Burning

In general, merchantable timber is least subject to fires, while grass areas are the most inflammable. Immature timber (second-growth and reproduction) occupies an intermediate position; scrub oak, pine, aspen, hardwoods, and swamp timber are decreasingly vulnerable.

The relative risk of burning or inflammability of each of these cover types and the per cent of the total area of each burned is shown by Figure 20, based on a study made by the Lake States Forest Experiment Station covering a five-year period (1928-1932).

Causes of Forest Fires

In Michigan, as in most states, forest fires are largely man caused. Less than three per cent on the average are started by lightning. The outstanding causes are smoking, land clearing, and railroad operation. Based on the records of the past ten years (1939-1948) the chief causes of forest fires in the order of importance are:

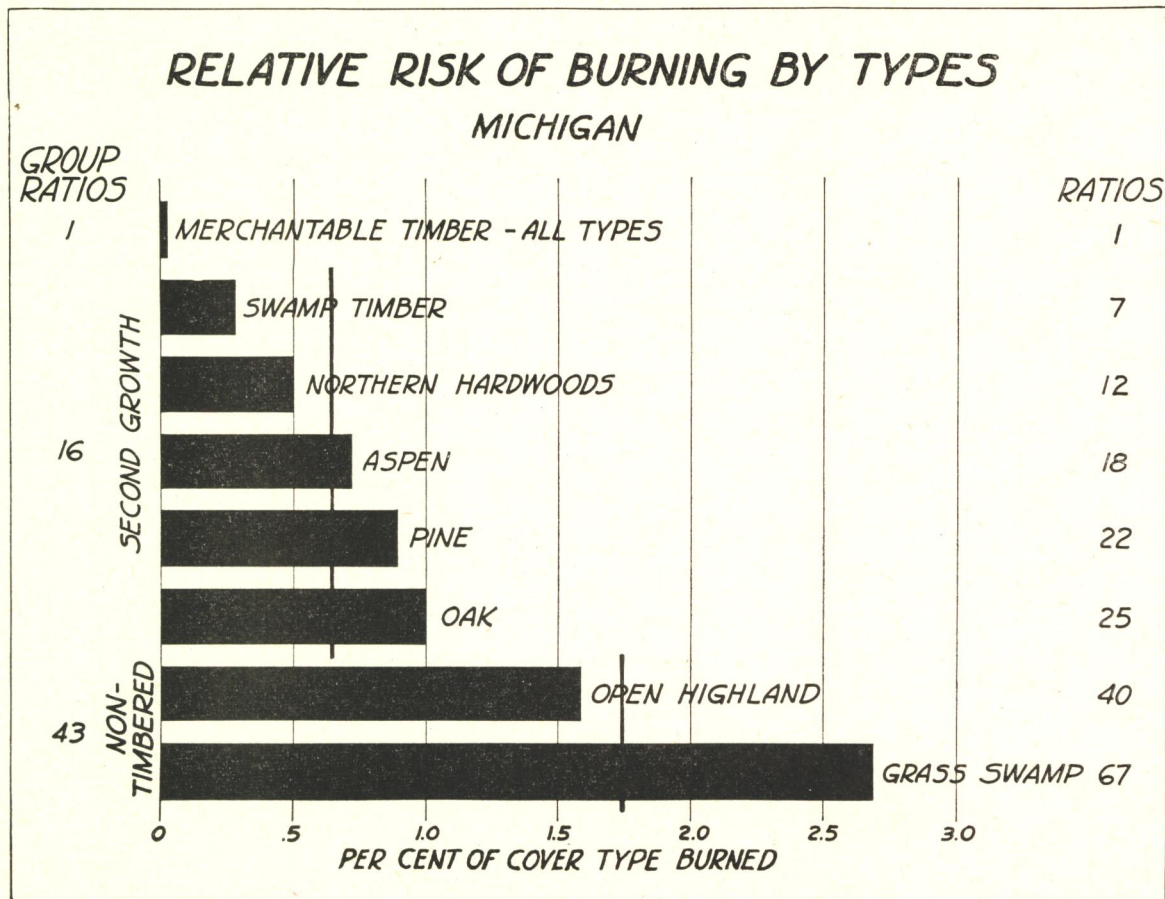


Figure 19—Relative risk of burning by cover type, Michigan.

	Per cent
Smoking	41.7
Land clearing	16.6
Railroads	15.8
Campfires	4.6
Lightning	3.0
Incendiary	2.7
Logging	1.2
Miscellaneous	12.9
Unknown	1.5

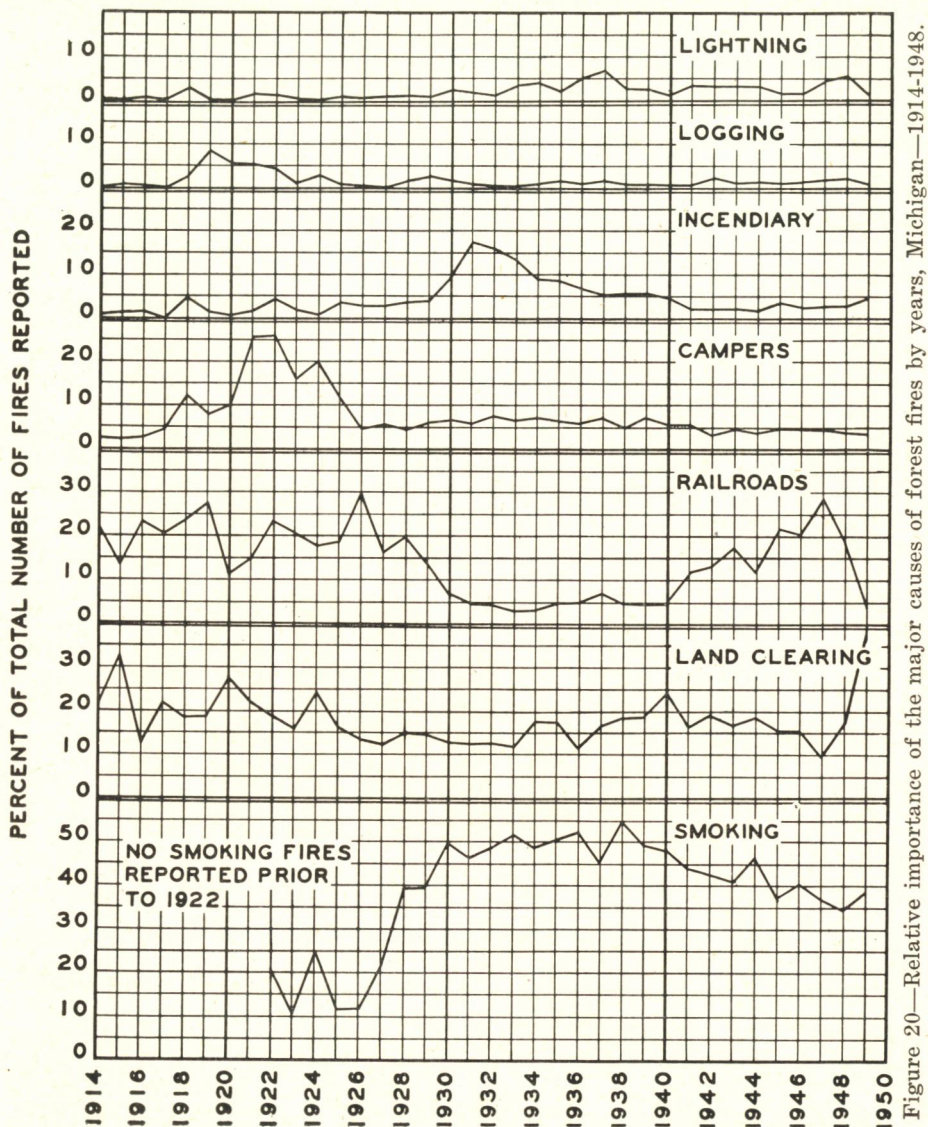


Figure 20—Relative importance of the major causes of forest fires by years, Michigan—1914-1948.

Listed as miscellaneous are fires resulting from the burning over of blueberry lands and meadows, bonfires, sparks from chimneys, smoking out bees and animals, building and haystack fires, right-of-way clearing, and children playing with matches. From the above it is apparent that the underlying cause of most forest fires is human carelessness or failure to take necessary precautions.

While data for the earlier years of fire protection are not complete, the information available shows the relative importance of the major causes of forest fires from year to year (Figure 21). It is of interest, for example, that the relative importance of logging, camper, land clearing and (since 1938) smoker's fires has decreased. Railroad fires, on the other hand, decreased sharply between 1926 and 1931, but increased from 1940 to 1947, largely because of heavy traffic and poor coal. The present trend, however, is downward. An upsurge in the per cent of incendiary fires occurred during the early years of the depression when many fires were set to make work.

The relative importance of the various causes by districts and regions is shown in Table 6. While smoking is the outstanding cause of fires in all districts, it varies in relative importance from 31.3 per cent of the total in District 12 to 52.3 per cent in District 8. Railroad fires rate second place in Districts 2, 3, and 6, but are relatively less important in other districts. In general, lightning and logging fires decrease in relative importance from north to south, while debris burning or land-clearing fires tend to increase. Campfires are most important in Districts 1, 7, and 12, while incendiary fires occur most frequently in District 4.

An analysis made in 1948 of the class of people responsible for starting forest fires indicates that transients and farmers are the worst offenders, followed by sportsmen (hunters and fishermen). The per cent of fires for which each class of people was responsible is as follows:

	Per cent
Transients	17.1
Farmers	15.9
Hunters	6.4
Fishermen	4.8
Woods workers	4.2
Others	3.6
Unclassified ¹	48.0
	<hr/> 100.0

Distribution and Concentration of Fires

While forest fires occur throughout the state wherever forest or wild land is found, their frequency and concentration varies with the hazard and risk prevailing locally; that is, with the character and amount of inflammable material or fuel present and the chance of its ignition. Thus fires are most frequent where the more inflammable fuels, such as grass, forest litter and slash abound, and where causative agencies

¹Includes railroads and other fires not chargeable to a specific class of people.

Table 6.—Relative importance of the principal causes of forest fires, by region and district, Michigan—1936-1947

Region and district	Lightning	Smoking	Debris burning	Rail- roads	Camp- fires	Incen- diary	Lumber- ing	Miscel- laneous	Unknown	Total
Per cent of total number of fires										
Region I										
District 1.....	9.7	39.3	10.1	9.9	9.2	4.2	3.1	12.2	2.3	100.0
2.....	1.6	44.5	12.7	17.1	5.4	5.1	0.8	10.3	2.5	100.0
3.....	4.2	43.6	12.9	13.3	5.6	4.1	2.5	9.4	4.4	100.0
4.....	6.6	40.8	14.8	6.6	4.6	9.9	2.0	6.6	8.1	100.0
Total for Region I....	5.0	42.5	12.8	12.2	5.9	5.9	1.9	9.5	4.3	100.0
Region II										
District 5.....	1.6	48.3	20.6	6.5	4.2	4.4	0.5	11.2	2.7	100.0
6.....	2.2	42.3	11.1	25.0	4.1	1.1	0.5	12.9	0.8	100.0
7.....	1.6	49.6	16.3	4.8	6.3	3.0	0.4	12.2	5.8	100.0
8.....	0.8	52.3	17.9	8.2	4.2	1.8	0.2	13.2	1.4	100.0
9.....	0.5	48.5	23.1	7.7	4.5	4.0	0.1	8.4	3.2	100.0
Total for Region II....	1.3	48.3	18.2	10.3	4.5	3.0	0.3	11.5	2.6	100.0
Region III										
District 10.....	0.4	42.6	24.0	7.6	3.3	3.3	0.1	8.2	10.5	100.0
11.....	0.3	40.2	19.0	5.3	4.7	1.9	0.3	8.7	19.6	100.0
12.....	0.0	31.3	19.6	4.3	15.4	1.2	0.6	7.4	20.2	100.0
Total for Region III..	0.4	41.1	22.6	6.8	4.7	2.9	0.2	8.2	13.1	100.0

are most active, as along railroads, highways, and in the vicinity of settlements.

In general the number of fires is greatest in the northwestern half of the Lower Peninsula (Figure 22). For the state as a whole, based on 12 years' records (1936-1947), the average number of fires per year was 1,430, the maximum 2,556, and the average risk of fire occurrence or number of fires per year per 100,000 acres protected is 7.0. By counties this varies from 0.0 in Monroe County to 32.8 in Muskegon County. By districts, risk varies from 1.0 in District 12 to 14.7 in District 8 (Table 7). It should be noted, however, that the record for the southern counties is incomplete and hence tends to underrate the risk prevailing in Region III.

Table 7.—Fire occurrence (State fires only), by region and district, Michigan—1936-1947¹

Region and district	Number of fires per year			Risk of fire occurrence ²
	Average	Maximum		
		Number	Year	
State.....	1,429.9	2,556	1936	7.0
Region I.....	506.6	969	1936	7.0
District 1.....	91.7	207	1936	5.1
2.....	165.5	325	1947	11.2
3.....	121.3	210	1936	7.4
4.....	128.1	337	1936	5.4
Region II.....	763.3	1,439	1936	10.2
District 5.....	204.1	365	1936	8.6
6.....	140.6	268	1936	10.2
7.....	112.3	228	1936	7.9
8.....	160.2	323	1936	14.7
9.....	146.1	263	1938	12.1
Region III ³	160.0	349	1946	2.9
District 10.....	112.0	248	1946	6.0
11.....	31.6	71	1946	1.6
12.....	16.4	31	1944	1.0

¹National Forest fires excluded.

²Average number of fires per year per 100,000 acres protected.

³Record for Region III incomplete.

The Forest Fire Season

The forest fire season in Michigan normally runs from the last of March to early November, with lulls in June and September, although fires can and do occur from the time snow leaves the ground in the spring until it returns in the fall. As a rule, more fires occur in the spring and fewer in the fall than in other seasons. Individual years, however, vary widely and the summer and fall fire seasons can be very acute. (Figure 23.)

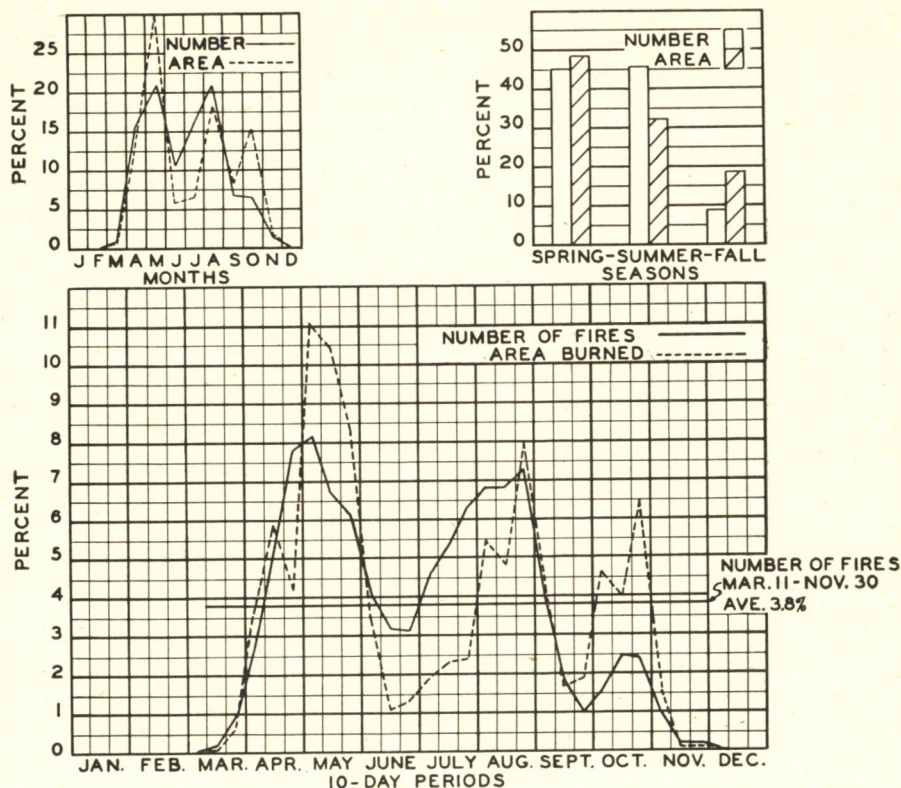


Figure 22—Average seasonal distribution of forest fires and area burned, Michigan.

For example, the peak periods of the past 13 years (1936-1948) have occurred eight times in the spring, three times in the summer, and two times in the fall. By 10-day periods the frequency of peak fire occurrence was as follows:

Spring		Summer		Fall	
March	21-31 (1)	July	11-20 (1)	October	1-10 (1)
April	11-20 (1)	August	1-10 (1)	October	11-20 (1)
April	21-30 (3)	August	11-20 (1)		
May	1-10 (2)				
May	21-31 (1)				

The variation in number of fires by 10-day periods is shown in Figure 24. This variation in frequency and seasonal distribution of fire occurrence presents a major problem for the protection organization. During the years 1936-1948, for example, protection organized at the average April-October level (Figure 24) would have been inadequate 22 per cent of the time. The number of 10-day periods in which an overload occurred, ranged from a minimum of two to a maximum of

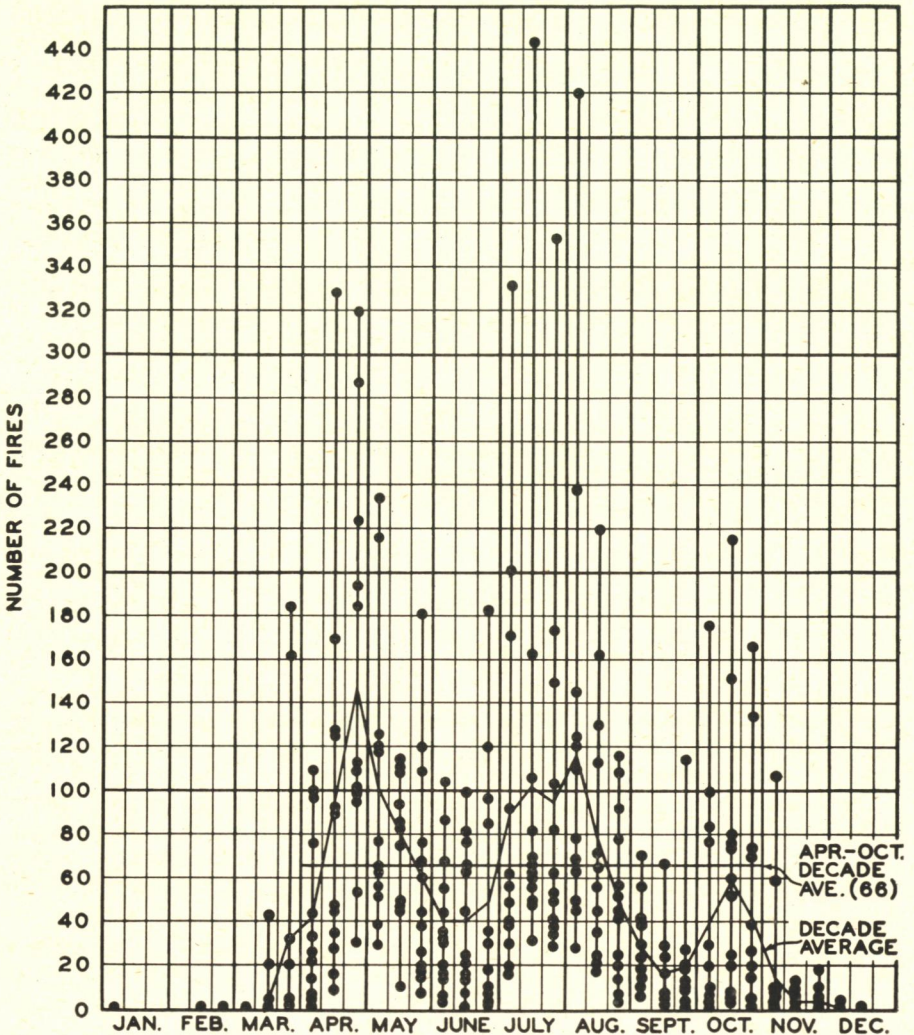


Figure 23—Number of fires, by 10-day periods, Michigan—1936-1948.

12 a year. While most likely to occur between April 10 and May 10, and between July 1 and August 20, overloads have occurred in every 10-day period from the last of March to the first in November, with the exception of the second period in September.

Burning Conditions

The over-all pattern of fire occurrence serves as a useful guide in planning protection efforts. The problem is complicated, however, by local as well as seasonal variation in the date, duration, and severity of acute periods. Effective protection, therefore, calls for the recog-

nition of the severity of conditions prevailing locally from day to day.

Until recent years, the only criterion of burning conditions was personal opinion. This left much to be desired. To provide more specific ratings, the Lake States Forest Experiment Station, in 1936, developed a Burning Index Meter which rates the severity of conditions prevailing on the basis of daily observations of conditions of vegetation (green, curing, or dead), amount of precipitation, days since rain, relative humidity, and wind velocity. This rating, or burning index, serves as a guide for administrative action and also provides a basis for comparing protection units and seasons.

The significance of these burning index ratings is indicated by the relative number and size of fires that occur at different burning index levels. For example, based on past experience, the average number and size of fires on days in each burning index class is as follows:

Class of day and burning index		Average number of fires per district per day	Average size of fires (acres)
Safe	(0-1)	0.11	4
Very low	(2-3)	0.19	5
Low	(4-6)	0.34	6
Moderate	(7-12)	0.61	10
High	(13-24)	1.08	14
Very high	(25-49)	1.92	24
Extreme	(50-100)	3.41	112

While the average number and size of fires on a given class day may vary from district to district, they increase or decrease with the burning index in approximately the ratio indicated.

The average burning index also provides a basis for rating years and protection units as to the relative severity of conditions prevailing. For example, based on the period from April 1 to October 31, the relative severity or per cent of the worst possible by years since 1942 was as follows:

Year	Relative severity (Per cent) ¹
1942	10.3
1943	11.0
1944	15.0
1945	10.5
1946	14.8
1947	13.8
1948	17.5

The average number of days in each burning-index class, together with the average relative severity rating, is shown in Table 8 by districts, regions, months, and seasons.

¹Relative severity or per cent of worst possible obtained by dividing the weighted number of days in each burning-index class by the total number of days multiplied by the weight given the highest burning-index class. Weights used are 1, 2, 4, 8, 16, 32, and 64 respectively for the classes safe through extreme.

Table 8.—Number of days in each burning index class and over-all relative severity, Michigan¹

Region and district	Burning index class							Average relative severity ²
	Safe (0-1)	Very low (2-3)	Low (4-6)	Moderate (7-12)	High (13-24)	Very high (25-49)	Extreme (50-100)	
	Average number of days, by protection units							Per cent
Region I								
District 1.....	86	40	35	23	16	11	3	9.2
2.....	82	37	39	27	16	10	3	9.3
3.....	78	42	38	31	13	9	3	9.1
4.....	77	38	36	26	18	13	6	11.7
Average.....	81	39	37	27	16	11	3	9.9
Region II								
District 5.....	37	44	40	42	26	20	5	14.3
6.....	50	30	38	42	32	17	5	14.3
7.....	49	44	43	41	22	12	3	11.4
8.....	71	34	39	31	21	14	4	11.8
9.....	40	36	38	44	30	21	5	15.2
Average.....	49	38	40	40	26	17	4	13.5
	Average number of days, by months							
Region I								
April.....	15	4	4	3	2	1	1	10.9
May.....	9	5	6	5	3	2	1	11.9
June.....	14	6	4	3	2	1	0	7.3
July.....	9	7	7	5	2	1	0	7.9
August.....	12	6	6	4	2	1	0	6.9
September.....	13	7	5	3	1	1	0	7.4
October.....	9	4	5	4	4	4	1	16.7
Region II								
April.....	6	4	4	6	5	4	1	18.3
May.....	9	5	5	4	4	3	1	14.0
June.....	9	7	6	5	1	1	1	9.6
July.....	6	6	7	7	4	1	0	10.2
August.....	5	5	7	7	4	3	0	13.0
September.....	8	6	7	6	2	1	0	10.3
October.....	6	5	4	5	6	4	1	18.9
	Average number of days, by seasons ³							
Region I								
Spring.....	28	11	12	9	5	4	2	10.9
Summer.....	40	22	19	13	6	2	0	6.9
Fall.....	13	6	6	5	5	5	1	15.5
Region II								
Spring.....	17	11	12	12	10	7	2	15.5
Summer.....	23	21	22	21	10	5	0	10.3
Fall.....	9	6	6	7	6	5	2	17.7

¹Basis: April-October data for 1942, 1943, 1946, 1947, and 1948 (5 years). Data for 1944, 1945, and for Region III lacking.

²Per cent of worst possible.

³Spring, April 1 to June 10; Summer, June 11 to September 20; Fall, September 21 to October 31.

Cost of Protection

Since State participation in forest fire control was first authorized in 1903, State protection expenditures have increased from a nominal authorization of \$5,000 for fire suppression to nearly \$1,500,000 a year.

Since fire control became effective the over-all cost per acre protected has risen from 2.3 cents in 1932 to 9.2 cents in 1948. About half of this increase, however, has been due to rising prices and wages.

At present price and wage levels, it is estimated that 11.2 cents per acre is needed to insure adequate protection.

Although varying from year to year with the severity of the season, the general trend of emergency expenditures has been downward as fire prevention and presuppression expenditures have increased. The value of an adequate protection organization is also shown by the smaller number of large fires and the fact that even in potentially bad years, such as 1941, 1944, 1946, 1947, and 1948, area burned has been held to a nominal figure. (Figure 25.)

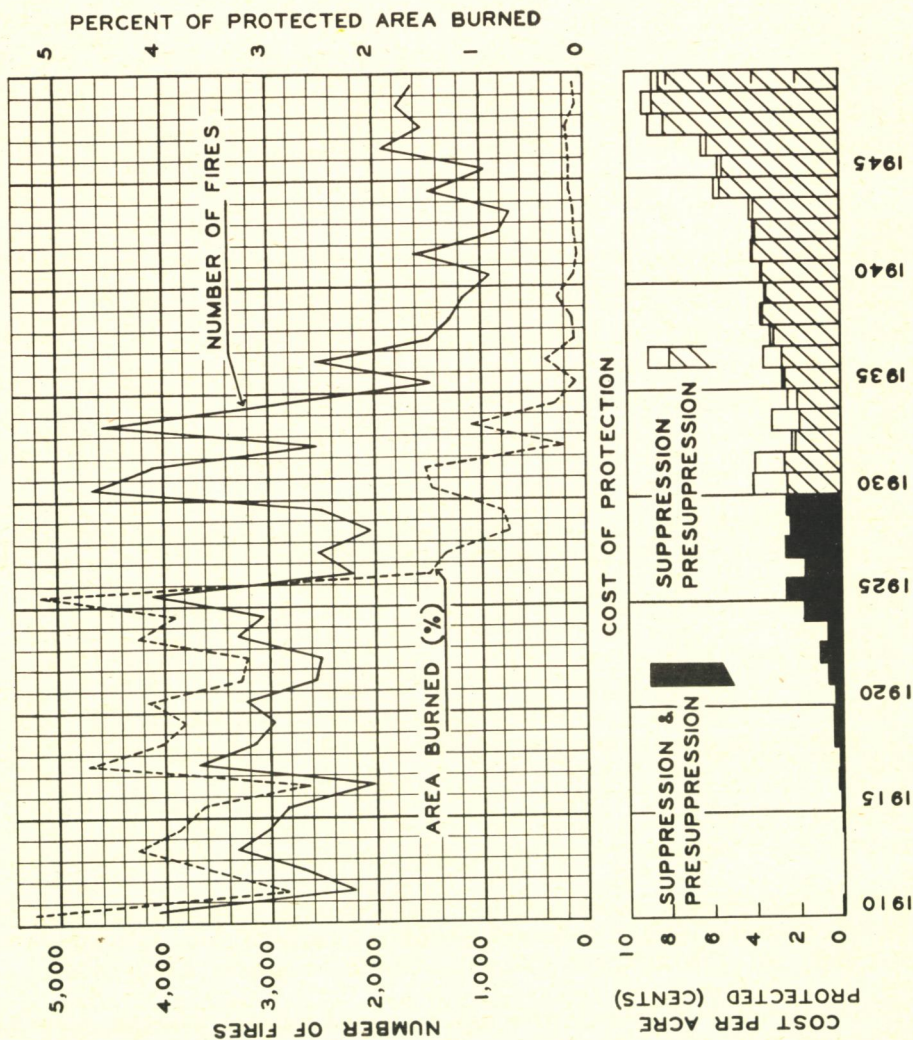


Figure 24—Number of fires, area burned, and cost of protection, Michigan—1910-1948.

Objectives

An objective is essential to give direction to any enterprise, and to provide a standard by which accomplishment can be judged. The overall objective of forest fire control may be stated as protection sufficient to make the ownership of forest property for timber production or other normal use an acceptable risk. Holding the average annual burn to two-tenths of one per cent in general accomplishes this purpose. This does not, however, preclude the possibility of large and destructive fires. More specific objectives are, therefore, necessary if protection is to be wholly satisfactory.

Since a few large fires annually are responsible for the bulk of the area burned and loss, a reduction in the number and size of large fires is essential if progress is to be made. Better fire prevention will help but does not wholly solve the problem. Early control is the key to the situation. Since most fires can be readily controlled if attacked soon enough, prompt action is of primary importance. Michigan's record for 1948 of 75 per cent of all fires attacked in less than 30 minutes, and 92 per cent in less than an hour after discovery indicates what has been achieved in this direction.

Effective initial attack is equally important. The minimum objective in this connection is control within the first work period or before fires start to run the following day. Control within a shorter period, however, is striven for and usually possible when fires are attacked promptly. In 1948, for example, 35 per cent of the fires were controlled in less than one hour, 61 per cent in less than two hours, while only eight per cent burned for more than 10 hours.

Looking Ahead

While forest fire control in Michigan today is reasonably adequate by present standards, past gains can be held and the present level of effectiveness maintained only by continued effort. The increasing chance of fires starting and the erratic occurrence of acute conditions present a constant challenge to the ingenuity and resourcefulness of the protection organization. Only by being prepared to function effectively whenever needed can it hope to keep the situation under control.

There is also need for better fire prevention. To put fires out is not enough. As far as possible they should be kept from starting. This means that the public at large must become fire conscious to a degree that care with fire is second nature. Education and publicity and stricter law enforcement are called for to accomplish this end. A start has been made but much more work along both these lines is needed.

Rising costs and increasing values, too, call for increased efficiency in the handling of fire suppression in order to reduce the number and size of large fires, for as has been pointed out, the relatively few large fires which still occur account for the bulk of the area burned, loss sustained, and suppression expenditures.

The uncertain seasonal occurrence of fires and the unpredictability of peak periods and emergency conditions present a major organization problem not yet satisfactorily solved. Combining fire control with

other activities in order to provide an adequate emergency reserve of trained fire personnel is one answer, but this fails if other activities are allowed to interfere. Combining fire control with conservation law enforcement as has been done in Michigan, has drawbacks as well as advantages. The same can be said, however, of combining fire control with other forestry activities as is done in some other states.

Fire control, however, is not an end in itself. Public safety and productive land use are its major purposes. In northern Michigan, for example, timber production, game management, and recreation development are the ultimate goals. With these activities adequately provided for and fully organized, fire control should become more or less incidental. To be effective, however, it will still require top priority. In the southern counties, on the other hand, where agriculture and industry predominate and forest values are less important, forest fire control is primarily a matter of rural fire protection and could well be developed in cooperation with local efforts in this direction, thus meeting an urgent need that would more than justify the expenditure necessary.

What the future holds no one can say. New hazards, new needs, and new techniques may change the picture, but the need for organized forest fire control will remain. It has been demonstrated that forest fires can be controlled. Ahead lies the job of holding the ground gained, meeting new problems as they arise, and improving on past performance.

APPENDIX

Table 9.—Total land area and area in need of protection, by county, protection district and region, Michigan—1949

Region, protection district, and county	Gross land area ¹	Area in need of protection ²		Protected by—		
		Acres	Acres	Per cent	U.S. Forest service Acres	State Acres
REGION I						
District 1:						
Baraga.....	578,560	555,420	96.0	45,904	505,516	
Gogebic.....	711,680	683,337	96.0	403,931	279,406	
Houghton.....	659,200	591,751	89.8	197,489	394,266	
Keweenaw.....	348,160	346,274	99.5	³ (133,839)	212,435	
Ontonagon.....	845,440	804,750	95.2	404,390	400,360	
Total, district 1....	3,143,040	2,981,532	94.9	1,051,714	1,795,979	
District 2:						
Dickinson.....	484,480	450,685	93.0	.....	450,685
Iron.....	766,080	736,083	96.1	267,531	468,552	
Menominee.....	660,480	560,825	84.9	.....	560,825
Total, district 2....	1,911,040	1,747,593	91.4	267,531	1,480,062	
District 3:						
Alger (West half).....	337,100	323,960	96.1	180,674	143,286	
Delta.....	755,200	683,404	90.5	316,810	366,594	
Marquette.....	1,178,240	1,130,003	95.9	11,200	1,118,803	
Total, district 3....	2,270,540	2,137,367	94.1	508,684	1,628,683	
District 4:						
Alger (East half).....	247,220	240,635	97.3	40,694	199,941	
Chippewa.....	1,011,200	882,401	87.3	301,667	580,734	
Luce.....	584,960	572,045	97.8	.....	572,045
Mackinac.....	648,960	621,695	95.8	201,750	419,945	
Schoolcraft.....	767,360	748,905	97.6	157,075	591,830	
Total, district 4....	3,259,700	3,065,681	94.0	701,186	2,364,495	
Total, Region I.....	10,584,320	9,932,173	93.8	2,529,115 ¹ (133,839)	7,269,219	
REGION II						
District 5:						
Alpena.....	363,520	288,167	79.3	.....	288,167
Antrim.....	305,280	240,919	78.9	.....	240,919
Charlevoix.....	264,960	211,071	79.7	.....	211,071
Cheboygan.....	464,000	402,944	86.8	.....	402,944
Emmet.....	295,040	242,489	82.2	.....	242,489
Montmorency.....	355,200	334,495	94.2	.....	334,495
Otsego.....	339,200	304,724	89.8	.....	304,724
Presque Isle.....	418,560	355,811	85.0	.....	355,811
Total, district 5....	2,805,760	2,380,620	84.8	.....	2,380,620
District 6:						
Benzie.....	202,240	159,178	78.7	.....	159,178
Grand Traverse.....	296,960	203,330	68.5	.....	203,330
Kalkaska.....	360,960	315,083	87.3	.....	315,083
Leelanau.....	223,360	153,225	68.6	.....	153,225
Manistee.....	357,120	284,500	79.7	147,467	137,033	
Missaukee.....	361,600	287,232	79.4	.....	287,232
Wexford.....	360,320	288,827	80.2	167,294	121,533	
Total, district 6....	2,162,560	1,691,375	78.2	314,761	1,376,614	
District 7:						
Alcona.....	433,280	384,188	88.7	137,743	246,445	
Crawford.....	360,320	354,716	98.4	75,487	279,229	
Iosco.....	350,080	305,016	87.1	175,512	129,504	
Ogemaw.....	367,360	300,689	81.9	31,163	269,526	
Oscoda.....	361,600	344,623	95.3	181,308	163,315	
Roscommon.....	333,440	326,110	97.8	.....	326,110
Total, district 7....	2,206,080	2,015,342	91.4	601,213	1,414,129	

Table 9.—Total land area and area in need of protection, by county, protection district and region, Michigan—1949—*Continued*

Region, protection district, and county	Gross land area ¹	Area in need of protection		Protected by—	
		Acres	Per cent	U.S. Forest service Acres	State Acres
District 8:					
Lake.....	366,080	336,383	91.9	213,930	122,453
Mason.....	315,520	214,342	67.9	140,766	73,576
Mecosta.....	360,320	225,888	62.7	.....	225,888
Muskegon.....	322,560	234,566	72.7	.....	234,566
Newaygo.....	548,480	422,768	77.1	345,619	77,149
Oceana.....	343,040	226,172	65.9	124,426	101,746
Osceola.....	371,840	257,732	69.3	.....	257,732
Total, district 8....	2,627,840	1,917,851	73.0	824,741	1,093,110
District 9:					
Arenac.....	235,520	155,331	66.0	.....	155,331
Bay.....	285,440	107,148	37.5	.....	107,148
Clare.....	366,080	303,389	82.9	.....	303,389
Gladwin.....	321,920	254,979	79.2	.....	254,979
Isabella.....	366,080	168,828	46.1	.....	168,828
Midland.....	332,800	222,556	66.9	.....	222,556
Total, district 9....	1,907,840	1,212,231	63.5	.....	1,212,231
Total, Region II.....	11,710,080	9,217,419	78.7	1,740,715	7,476,704
REGION III					
District 10:					
Allegan.....	530,560	249,219	47.0	.....	249,219
Barry.....	351,360	152,163	43.3	.....	152,163
Berrien.....	371,200	133,456	36.0	.....	133,456
Cass.....	312,320	119,476	37.2	.....	119,476
Ionia.....	368,000	133,113	36.2	.....	133,113
Kalamazoo.....	362,880	164,892	45.4	.....	164,892
Kent.....	551,680	248,734	45.1	.....	248,734
Montcalm.....	455,680	219,065	48.1	.....	219,065
Ottawa.....	360,960	156,634	43.4	.....	156,634
St. Joseph.....	325,120	109,942	33.8	.....	109,942
Van Buren.....	388,480	171,635	44.2	.....	171,635
Total, district 10....	4,378,240	1,858,379	42.4	.....	1,858,379
District 11:					
Branch.....	323,840	132,336	40.9	.....	132,336
Calhoun.....	453,760	209,255	46.1	.....	209,255
Clinton.....	365,440	106,728	29.2	.....	106,728
Eaton.....	362,880	116,719	32.2	.....	116,719
Gratiot.....	362,240	117,871	32.5	.....	117,871
Hillsdale.....	384,640	138,745	36.1	.....	138,745
Ingham.....	357,760	146,909	41.1	.....	146,909
Jackson.....	451,200	216,941	48.1	.....	216,941
Lenawee.....	482,560	160,588	33.3	.....	160,588
Livingston.....	365,440	183,613	50.2	.....	183,613
Saginaw.....	519,680	190,978	36.7	.....	190,978
Shiawassee.....	345,600	102,556	29.7	.....	102,556
Washtenaw.....	458,240	203,875	44.5	.....	203,875
Total, district 11....	5,233,280	2,027,114	38.7	.....	2,027,114
District 12:					
Genesee.....	412,160	164,362	39.9	.....	164,362
Huron.....	526,080	160,908	30.6	.....	160,908
Lapeer.....	421,760	157,602	37.4	.....	157,602
Macomb.....	307,840	111,859	36.3	.....	111,859
Monroe.....	359,680	114,000	31.7	.....	114,000
Oakland.....	561,280	290,324	51.7	.....	290,324
St. Clair.....	473,600	202,084	42.7	.....	202,084
Sanilac.....	615,040	154,364	25.1	.....	154,364
Tuscola.....	522,240	201,859	38.7	.....	201,859
Wayne.....	388,480	112,771	29.0	.....	112,771
Total, district 12....	4,588,160	1,670,133	36.4	.....	1,670,133
Total, Region III.....	14,199,680	5,555,626	39.1	.....	5,555,626
State total.....	36,494,080	24,705,218	67.7	4,269,830	420,301,549

¹Total land area from 1945 Agricultural Census.²Total land area minus cropland and area of cities and towns with over 1,000 population.³Isle Royale National Park protected by National Park Service.⁴Includes 207,461 acres of federal land outside of National Forest protection areas.

Table 10.—State Forest Fire Statistics (State protected area), by calendar years, Michigan—1925-1949

Year	Number of fires	Area burned	Size of average fire	Damage reported	Cost			Year
					Prevention	Suppression	Total	
		Acres	Acres	Dollars	Dollars	Dollars	Dollars	
1925....	3,852	725,928	188	475,120	233,224	132,969	366,193	....1925
1926....	1,499	141,632	94	101,730	234,365	19,949	254,314	....1926
1927....	2,380	94,477	40	71,050	341,316	41,267	382,583	....1927
1928....	1,294	66,675	52	126,584	337,967	21,148	359,115	....1928
1929....	2,395	49,811	21	95,879	337,912	47,288	385,200	....1929
1930....	4,633	280,497	61	518,899	431,164	393,612	824,776	....1930
1931....	4,133	282,979	68	457,569	483,065	265,752	748,817	....1931
1932....	2,536	39,034	15	53,830	386,496	42,699	429,195	....1932
1933....	4,557	202,090	44	368,520	297,043	290,570	587,613	....1933
1934....	3,038	53,016	17	85,251	353,523	118,524	472,047	....1934
1935....	1,457	18,120	12	32,938	432,311	31,851	464,162	....1935
1936....	2,556	56,560	22	143,273	377,290	169,428	546,718	....1936
1937....	1,286	16,730	13	33,521	458,395	42,090	500,485	....1937
1938....	1,302	19,843	15	57,852	545,745	24,912	570,657	....1938
1939....	1,272	47,071	37	263,786	587,357	27,378	614,735	....1939
1940....	899	17,388	19	48,741	547,334	12,082	559,416	....1940
1941....	1,604	10,463	7	26,820	594,538	36,609	631,147	....1941
1942....	897	16,072	18	50,900	667,110	38,136	705,246	....1942
1943....	763	20,660	27	71,828	684,293	55,822	740,115	....1943
1944....	1,642	30,030	18	103,923	858,142	63,851	921,993	....1944
1945....	959	22,881	24	88,947	901,894	35,769	937,663	....1945
1946....	1,923	23,138	12	93,205	960,729	72,453	1,033,182	....1946
1947....	1,539	24,851	16	158,724	1,253,607	156,410	1,410,017	....1947
1948....	1,778	14,856	8	81,670	1,353,610	111,356	1,464,966	....1948
1949....	1,624	21,108	13	128,708	1,312,453	69,243	1,381,696	....1949

Table 11.—Number of fires, by cause, size class, and year, Michigan—1925-1949

Year	Cause										Size class				Year
	Light- ning	Rail- roads	Campers	Smokers	Debris burning	Incen- diary	Lum- bering	Miscel- laneous	Un- known	Total	"A" 0-¼ acres	"B" ¼-10 acres	"C" Over 10 acres	Total	
1925 . . .	121	446	623	196	694	424	13	39	1,296	3,852	355	1,088	2,409	3,852	1925
1926 . . .	12	442	64	174	205	33	0	52	517	1,499	175	772	552	1,499	1926
1927 . . .	24	386	122	499	301	70	0	202	776	2,380	250	1,406	724	2,380	1927
1928 . . .	13	258	54	506	189	58	17	86	113	1,294	91	756	447	1,294	1928
1929 . . .	24	318	138	947	355	120	59	249	185	2,395	314	1,459	622	2,395	1929
1930 . . .	115	312	295	2,293	589	440	51	352	186	4,633	519	2,604	1,510	4,633	1930
1931 . . .	74	176	225	1,900	514	738	23	231	252	4,133	401	2,285	1,447	4,133	1931
1932 . . .	27	104	176	1,243	318	395	12	162	99	2,536	312	1,605	619	2,536	1932
1933 . . .	149	126	272	2,340	534	631	17	339	149	4,557	624	2,780	1,153	4,557	1933
1934 . . .	100	81	212	1,500	551	252	21	225	96	3,038	535	1,965	538	3,038	1934
1935 . . .	22	47	86	741	256	131	17	116	41	1,457	292	954	211	1,457	1935
1936 . . .	100	101	154	1,355	311	190	13	260	72	2,556	619	1,597	340	2,556	1936
1937 . . .	56	76	93	592	207	75	19	129	39	1,286	365	773	148	1,286	1937
1938 . . .	29	43	53	731	238	79	5	93	31	1,302	232	845	225	1,302	1938
1939 . . .	26	42	77	602	251	84	9	129	52	1,272	225	856	191	1,272	1939
1940 . . .	7	26	50	424	226	47	4	76	39	899	110	602	187	899	1940
1941 . . .	46	188	92	706	266	34	10	194	68	1,604	313	1,136	155	1,604	1941
1942 . . .	20	100	31	390	186	15	18	98	39	897	173	619	105	897	1942
1943 . . .	17	105	27	327	150	14	7	74	42	763	91	546	126	763	1943
1944 . . .	36	139	57	778	339	21	15	191	66	1,642	199	1,120	323	1,642	1944
1945 . . .	10	181	45	362	168	31	5	117	40	959	148	617	194	959	1945
1946 . . .	22	348	83	787	306	46	22	229	80	1,923	258	1,367	298	1,923	1946
1947 . . .	58	439	53	575	151	41	27	163	32	1,539	245	1,091	203	1,539	1947
1948 . . .	78	296	55	622	322	48	34	230	93	1,778	331	1,221	226	1,778	1948
1949 . . .	18	63	56	624	602	71	9	134	47	1,624	251	1,015	358	1,624	1949

REFERENCES CONSULTED

- Anonymous
 1939 Great fires of the past
 American Forests 45(4):160. April 1939
- Bailey, Sargent William O.
 1882 Report on the Michigan forest fires of 1881
 War Department, Signal Service Notes No. 1
- Cunningham, Russell N. and Forest Survey Staff
 1946 Revised forest statistics for the Lake States, 1945
 Lake States Forest Expt. Sta. Station Paper No. 1, processed,
 27 pp. (Sept. 1946)
- Dana, Samuel T.
 1939 Fire over the Lake States
 American Forests 45(4):170-172, 234 (April 1939)
- Donery, J. A.
 1935 Michigan forests—a great resource
 American Forests 51(5):218-221, 255-256 (May 1945)
- Goodspeed, E. J.
 1871 History of the great fires in Chicago and the west
 New York
- Guthrie, John D.
 1936 Great Forest Fires of America
 U.S. Dept. Agr., Forest Service, Unnumbered publ., 10 pp.
- Harwood, W. S.
 1894 Forest fires in the northwest
 Harpers Weekly 38:880. Sept. 15, 1894
- Herbert, Paul A.
 1928 Forest fire insurance and its application in Michigan
 Mich. Agr. Expt. Sta. Spec. Bul. No. 179, 34 pp., East Lansing
- Holbrook, Stewart H.
 1939 When Peshtigo burned
 American Forests 45(4):158-160. April 1939
-
- 1943 Burning an empire. Chapter 9: "And then Michigan"
 The MacMillan Company, New York
- Michigan Department of Conservation
 Biennial reports
- | | |
|-----|---------|
| | 1923-24 |
| | 1925-26 |
| 4th | 1927-28 |
| 5th | 1929-30 |
| 6th | 1931-32 |
| 7th | 1933-34 |
| 8th | 1935-36 |

9th	1937-38
10th	1939-40
11th	1941-42
12th	1943-44
13th	1945-46
14th	1947-48

Michigan Department of Conservation

Annual Forest Fire Reports

1921	(See Dept. of Conservation biennial reports, 1922-30)
1931	(processed)
1932	"
1934	"
1935	"
1946	"
1947	"
1948	"

Conferences

1888	Report of forestry conference, Grand Rapids, Michigan Mich. Agr. Expt. Sta. Bul. 32
1916	Proceedings of forest fire congress, Lansing, Michigan March 13-14, 1916
1922	Proceedings of forestry conference, Lansing, Michigan November 28, 1922
1924	Proceedings of conservation conference, Lansing, Michigan December 10-11, 1924

Miscellaneous Publications

	The Michigan Department of Conservation; its organization and functions, 20 pp., illus.
	Menace of the forest fire
1932	The Michigan forest fire experiment station
1935	A conservation handbook for women's organizations
1938	Michigan forest fire laws—including rules and suggestions relative to the careless use of fire
1939	Forest fire fighting in Michigan
1942	Fire fighting equipment for rural areas
1942	Conservation club handbook
1942	Rural fires: their prevention and control
1942	They need not vanish: a discussion of the natural resources of Michigan
1943	Forest fire fighters manual

Michigan Forestry Commission

1900	A little talk about forestry. Misc. Pub.
1900	Annual report
1901	Annual report—"Steps of Progress in Michigan Forestry"
1902	Annual report
1903-4	Biennial report
1905-6	Biennial report
1907-8	Biennial report

Michigan Game, Fish, and Forestry Warden

1907-8 11th Biennial report

1912 Annual report

1912 Annual forestry report to public domain commission—
“What Michigan is doing in regard to forest fire protection”

1913-14 Biennial report to the Governor

Michigan Game, Fish, and Forestry Department

Biennial report to public domain commission

1915-16

1917-18

1919-20

Michigan Public Domain Commission

Reports

July 8, 1909–December 31, 1910

January 1, 1911–June 30, 1913

Biennial reports

July 1, 1914–June 30, 1916

July 1, 1916–June 30, 1918

July 1, 1918–June 30, 1920

Annual forest fire reports

1915

1916

Michigan State College

1890 Upper Peninsula forests

Mich. Agr. Expt. Sta. Unnumbered Bul.

1898 Reforesting stump lands, meteorology of the forests, forestry
legislation, original white pine in the Lower Peninsula. Mich.
Agr. Expt. Sta. Bul. No. 162

Forest fires

4-H Bul. No. 31 and 31A

Mitchell, J. A. and H. R. Sayre

1931 Forest fires in Michigan

Mich. Dept. of Conserv. Bul., 65 pp., illus.

Northern Forest Protective Association

1911 Constitution and by laws

1916 Proceedings of the 5th annual meeting: a review of the work
of the association

Plummer, Fred G.

1912 Forest fires: their causes, extent and effects, with a summary
of recorded destruction and loss

U.S. Dept. Agr., Forest Service, Bul. No. 117, 39 pp., illus.

Reynolds, Robert Van R.

1939 Forest products statistics of the Lake States

U.S. Dept. Agr. Statistical Bul. No. 68

Rudolf, Paul O.

- 1946 The reforestation job in the Lake States—a new estimate
Lake States For. Expt. Sta. Station Paper No. 4

Sparhawk, William N.

- 1925 The use of liability ratings in planning forest fire protection
Jour. Agr. Res. 30:8-693-762
1929 The economic aspects of forest destruction in northern Michigan
U.S. Dept. Agr. Tech. Bul. No. 92

Stewart, Gilbert I.

- 1934 Use of shallow wells in forest fire fighting
Mich. Dept. of Conservation Unnumbered Misc. Pub., 64 pp.

